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GENERATORS EXTRAORDINARY.

In the new developments initiated on the Canadian side of the Niagara another high-water mark has been established in generator construction. Nothing show more strikingly the advance in electrical engineering during the last decade than the tremendous installation now under way. When the original plant was put in, the demand for 5000-hp generators rather staggered manufacturers for a time, but before the contracts had to be let, they had recovered their equanimity and turned out the huge machines with entire success. They were, however, for very moderate voltage, and the newness of the problems involved led to much caution in the mechanical design. It is difficult to see, at least in the light of subsequent development in design, any adequate reason for the plan of using an external revolving field. Of all possible designs it was the one rendering the armature most inaccessible, and with less skillful and substantial construction, this would have proved a serious fault. In the new machines just ordered, not only is the output doubled at one stroke, but the resulting machines will be directly in the line of progress of the ordinary best practice at the beginning of the twentieth century. Their efficiency will probably be a shade higher than the rest of the present machines, but at these huge outputs a few thousand horse-power one way or the other ought to make no perceptible difference in efficiency, and the monsters of 1902 may no more than equal their predecessors. The whole station arrangement will be much simplified and not a little cheapened by the use of 10,000-hp units which, from the standpoint of the total development in sight, must be considered small rather than large.

It seems strange to think of so enormous a power plant, that the largest dynamos ever built compel the use of what in any other station would be an unreasonably large number of units. The change from 5000 to 10,000 hp was an eminently wise one. But far more striking was the upward step from 2200 volts to 12,000 generated in the armature. When a plant reaches such superlative dimensions that the current at 2200 volts becomes of troublesome magnitude and involves all sorts of switchboard difficulties, it is surely time to move on, quite aside from any considerations involving the transmission lines. In fact, if transmission is undertaken from this plant upon a great scale, the line will carry so high a pressure, and the transformer units will be so huge, that a 12,000-volt winding for the low-pressure side will seem only an indication of reasonable symmetry in design. Working on such a scale there is not the slightest difficulty in winding the stationary armature for 12,000 volts, and indeed it would be no difficult matter to put the pressure up to 20,000. But this latter figure is to-day a very conservative datum for a long distance line, and viewing the matter in its proper perspective, the 12,000-volt armature is really only a matter of convenience in local distribution. For real transmission, 30,000 to 60,000 volts will be the figure. Another matter of interest is the admirable inherent regulation of these great machines. We hope such an example as this will put a permanent quietus on those who have strenuously insisted that the only generator to use was one that gave bad regulation. The real truth of the matter is that it is cheaper to build badly regulating generators under certain circumstances, but bad regulation in machines for power transmission is an evil first, last and always, never to be tolerated when it can be avoided at any reasonable cost.

THE DAY LOAD OF A MODERATE SIZED STATION.

It has been the general belief among central station men that the lighting of factories and shops where the light is only used until 6 P. M., after which the factory is shut down, is not a profitable class of business, and not worth the going after, for the reason that the lights in such factories are used only in the winter, and cause an addition to the 6-o'clock peak, which represents an investment in generating machinery installed simply to take care of the factory lighting peak for a few months each year, and for a few hours a day at that. This, of course, is largely a matter of local conditions, but the experience of Mr. J. H. Harding, of La Porte, Ind., as related in the discussion at the last Northwestern Electrical Association (see ELECTRICAL WORLD AND ENGINEER, Jan. 25, 1902, pages 162 and 163), may be considered with profit by other stations similarly situated. It seems that Mr. Harding operates a plant in a manufacturing town, and that he disregarded the orthodox teaching that a factory load of this kind is not profitable, and started out to get a load for a day circuit. He found that the peak load from the factories in his town would come up long before the peak due to residence lighting, and as the two classes of lighting do not coincide in point of time, whatever lighting is taken by the factories is a direct gain for the company. More than this, in going after this factory business, which required a day circuit, and which practically ceased at 6 P. M., he found an unexpected load of incandescent all-day lights, which was entirely new business, and due to the fact that an all-day service was available for those who wished to use it. The station being in the heating business, this day load is very desirable. It was the general experience of those at the convention that they never before heard of a peak load coming on at 3 or 4 o'clock on winter afternoons, as in the case cited by Mr. Harding, but that may simply prove that there are a few things to be learned by a number of central station managers yet as to the possibilities of their field.

THE FUTURE OF NIAGARA FALLS.

The immense installation on the Canadian side of Niagara Falls means an enormous growth in local and distant business. It must be remembered that splendid and tremendous as the Niagara development has been, it is up to date largely a local plant. It has not yet stretched out its web of conductors over any very considerable radius. Buffalo, of course, receives a large amount of power, but as power transmission to-day goes, the Buffalo circuit is only an incident possessed of no unusual interest. The greatest mission of the Niagara Power Company is as yet unfulfilled. In the light of our present knowledge, Cleveland, Detroit, Columbus, Cincinnati and even Chicago and New York are within striking distance of the Niagara central station. How far transmission of huge amounts of power to these points would pay is a matter which cannot yet be determined, but the next few years will show clearly enough how the work can be done when it becomes desirable to attempt it. The effect of the Niagara power on Buffalo and neighboring cities is already manifest, and perhaps the whole immense output of the plant can be ultimately utilized, not so much by transmitting power as by drawing, even as by the hand of Fate, great industries about it. Power transmission then means only local distribution to a manufacturing metropolis spread out over a thousand square miles of territory. But it is idle to speculate on such matter as these. Time has the answers for all such questions, and not one yet has ever been able to formulate rules for the shifting of centers of population.

But how about the great cataract itself? The voice of prophecy has been already raised to foretell the day when the fall itself will be only a trickling sheet, and when great national holidays may be celebrated by turning the water for a few brief hours from the canals back to its natural channel. The men who have created the splendid power developments there are called iconoclasts and vandals who rend Nature limb from limb for dirty pelf. But truth to tell, Niagara was from every æsthetic point of view wrecked long before the pick opened the work of the Niagara Power Company. Ill-kept factories, garish barns of hotels, patent medicine advertisements, shanties of evil aspect and worse repute, had made the greatest cataract in the world an eyesore and reproach years ago. Even the strong hand of the State was stretched out too late to save, and man's petty avarice had undone already Nature's best work. To turn the stream thus defiled into a blessing for the world's workers is a worthy deed, a thing to be applauded. Had wise men taken the Niagara region three-quarters of a century ago and guarded it so that none of man's handiwork should visibly infringe on the eternal majesty of the scene, then would the mighty fall have been saved to art. Failing in this, it has been redeemed from vandals to the great service of Industry. It will be many a year, perhaps many a century, before Niagara ceases to be a natural wonder of the world, and long ere that it will be the greatest monument of man's victory over natural forces. Why should any one wish a better fate for it, since it had been already cast aside. In fact, if one looks far into the future, the work of utilizing the cataract may be its salvation. Even within the memory of man it has suffered greatly from erosion, and sooner or later it was bound to work its way westward, bringing disaster unless saved by the interposition of human aid in controlling its fateful march. One day a future generation may wake to the realization that the Niagara tunnels saved the Great Lakes.

MAGNETIC DEFLECTION OF LONG STEEL-WIRE PLUMB LINES.

Dr. Hallock's article on this subject on page 263 is an interesting communication upon a subject of practical importance. When an engineer has to support a plumb bob by a very long line, he naturally thinks at once of a steel pianoforte wire, which, however, is a magnetic substance, and liable to magnetic attraction. The article does not state the length of the two wires used in the actual case of the Lake Superior mine, except that they were used in connection with a very deep shaft, so that the magnitudes of the apparent angular deviations are not forthcoming, but the total relative deviations observed between the two suspended plumb bobs are virtually stated to have been in the neighborhood of one inch. Under these circumstances the mutual or relative deviation could hardly be due to the earth's magnetic pull upon the wires, because the two wires would probably be equally and similarly magnetized, and the attraction of the earth would, therefore, be equal on both, giving rise to an equal deflection of both from the perpendicular with no mutual deviation. Consequently, deviations are only to be readily explained from a magnetic point of view by virtue of mutual attractions and repulsions. If the wires were uniformly magnetized parallel to their length, their poles would be formed exclusively at the extremities, and these extremities would have like polarity so that a repulsion would necessarily be exerted. In other words, mutual magnetic actions would, by their symmetry, inevitably push the lower ends of the wires apart and could not cause them to incline towards each other. If, however, the magnetization of the wires happened to be broken up into a section of irregular segments with consequent superficial poles, then, as the article indicates, these consequent poles, if of opposite name at adjacent points on the wires might give rise to attraction, while if of the same name at adjacent points, would increase the repulsion due to simple terminal poles.

Dr. Hallock appears to have found a magnetic deflection of a pianoforte wire or magnetizable plumb line amounting to about 1½ seconds of arc, although the mass of the plumb bob and, therefore,

the vertical force, is not stated, so that the equivalent simple horizontal deflecting force is not forthcoming. Apparently, however, this deflection could not be accounted for on the assumption of simple terminal polarity, and could only be accounted for magnetically by the additional deflecting force of similar consequent poles along the wire. It is difficult to see how consequent poles could increase the deflection of a single wire, and the inference from the article seems to be that it could only augment the mutual deviation of two parallel wires. Apart from the matter of theory, however, and the complete explanation of the phenomenon, it seems clear that when accuracy is important, a plumb line is not a plumb line.

MEASURING THE VARIATION OF SPEED OF A FLYWHEEL DURING ONE REVOLUTION.

The direct connection of large alternators to steam engines means employing, in the present condition of steam engine practice, a series of steam-pressure impulses occurring only a comparatively small number of times in each second. This pulsation in the driving effort unavoidably produces some pulsation in the motion of the attached alternator and some corresponding variation in the frequency of the generated alternating e. m. f. The electrical and mechanical inertia of the moving parts tend, however, to reduce the pulsation, and it is often a matter of doubt as to just how much fluctuation exists in any particular direct-connected unit. An electro-mechanical apparatus is described on page 264 of this issue for measuring the pulsation, and also the angular variation of the moving parts involved. It consists essentially of two co-axial disks driven in opposite directions from the flywheel to be tested, one disk having as much inertia as can conveniently be given to it, and the other disk as little inertia as is conveniently possible. The former is driven elastically through a torsion wire in which variations of angular velocity are intended to be absorbed, while the latter is driven positively from the flywheel. The relative positions of the junctions of radial slits in these rapidly revolving disks is then observed optically.

The apparatus is ingenious, but its description suggests that some little mechanical skill may be necessary in adjusting and using it. The tell-tale spot of light would no doubt give its indications by trembling through a certain range on the scale, or giving a certain length of vibrational band, and any tremor or vibration in the instrument would be likely to increase the apparent amplitude of this band. It would, therefore, seem necessary that the apparatus should run very truly and smoothly in order to obtain reliable measurements. It would be interesting to have a report of an actual test with such an instrument and a comparison between the observed and calculated results.

IMPROVED ILLUMINANTS.

It is now some years since the investigations of Langley on the light of fireflies aroused a keen interest in the possible improvement of artificial illuminants. The idea of "cold light" is a peculiarly attractive one, and workers in this field of investigation are many. But the problem has thus far been approached mostly from the electrical side; the chemical side, which is really a promising direction of attack, having been rather neglected. There is so much general misunderstanding of the physical problems involved in the production of "light without heat" that it is really pertinent and worth the while to look into them a bit. To begin with, any refractory solid when sufficiently heated emits light at first of the long wave lengths toward the red end of the spectrum, and then, as the temperature rises, more and more refrangible rays ending at the highest temperatures with the extreme ultra-violet rays quite invisible to the human eye and detected only by their chemical activity. Long before the body becomes perceptibly luminous it is hot to the touch, and is sending out large quantities of long heat waves, which grow more and more intense as the temperature rises and visible radiation begins. These heat waves can be easily detected by their very powerful effect on a thermo-pile or bolometer, and, indeed, can be photographed by the use of chemicals suited to the purpose, so that Abney actually photographed a teakettle of hot water by its own radiation. And the fundamental difficulty with heated solids as illuminants is that all the time they are also giving out a very large amount of invisible heat waves, and a smaller but very perceptible amount of ultra-violet rays.

The worst of the matter is that all solids behave very much alike with respect to their radiation when heated, so that in spite of minor differences in their radiating power we do not find any body showing light until it is sending out ultra-violet rays before it shows light. Only a few very rare substances show a marked tendency toward selective radiation of a kind that might prove practically useful. And even these do not give cleanly selective radiation, but merely show in their spectra points of maximum radiation producing bands brighter than the rest of the spectra. The only really hopeful process of improving the usefulness of heated solids as sources of light seems to be by driving up the temperature so that a somewhat larger proportion than usual of the radiation may lie within the limits of the visible spectrum. From this point of view, it becomes quite evident that no known substance gives much hope of very great efficiency in the sense of having a very large proportion of its total radiant energy of the visible kind. The more refractory the substance the higher the temperature to which it can be driven and the better the efficiency, but it will not be really high in any case. The most striking results along this line of operations have been the experiments on arcs formed between tiny pencils of such material as is used for the glowers of Nernst lamps.

A more interesting line of operations is that of which the Cooper-Hewitt tube, several times of late referred to in our columns, is a good example. We are glad to see from some patents recently issued and referred to in our issue of Jan. 25 that Mr. Hewitt is extending his lines of investigation into new directions that may obviate some of the obvious objections to a tube lamp. In the general type, the radiating body is a gas brought to incandescence by an electric arc or spark. Now, gases uniformly give the very condition one would like to secure with solids, i. e., selective radiation in a very marked degree. Their spectra are of bright bands or lines without a background of continuous spectrum. These radiation bands, however, extend into the region of dark heat, and also into the ultra-violet, so that there must still be waste energy from the standpoint of illumination, but not necessarily, though usually, in large amount. But the rub in this case is to get a good working amount of light out of incandescent gas. The Cooper-Hewitt lamp is an unusually successful attempt at getting this brilliancy, but it is worked at a pretty stiff temperature and its efficiency, small thanks to the ultra-violet and infra red radiation, is no greater than is obtained in the form of arc just referred to. Driving a gas to a brilliancy that gives a useful light seems to cause waste of energy. Very little if any work has been done on the distribution of energy in gaseous spectra under varying conditions, but such a line of research would give a great deal of valuable information regarding the possibilities of vacuum tube lamps. The use of gaseous radiating bodies seems, however, to be a more promising line of operations than driving up the temperature of solids, and we hope that other investigators who have been working on gas or vapor lamps, as several have, will soon give us the results of their labors. They have, of course, the difficulty of color to contend with, but perhaps to no greater extent than the early Welsbach burners, and in working with gases color can be far more easily modified than in the case of solids. But 100 per cent of efficiency is still afar off.

A. I. E. E. Annual Convention.

At the recent meeting of Council of the American Institute of Electrical Engineers, it was voted to hold the next annual convention June 24-27 at Great Barrington, Mass.

New York Central.

A bill has been introduced in the New York State Senate empowering the State Board of Railroad Commissioners in its discretion to set a date when the New York Central Railroad Company shall substitute electricity for steam in the Park Avenue tunnel. A similar bill was introduced in the Assembly by Chairman Rogers, of the Judiciary Committee. In the event that the bill compelling the Central to substitute electricity for steam passes, it is understood that the Central will present to the Legislature a bill giving it the right to construct an elevated road down Eleventh Avenue from a point below the Harlem River to Canal Street. If the Central can secure this concession, it will, it is said, abandon its Forty-second Street station and purchase property for a new station, either at Canal Street, Fourteenth Street or Twenty-third Street and Hudson River. It is said that the cost of this project would not be so greatly in excess of the cost of substituting electricity for steam that the Central would be glad of the opportunity to undertake it for the great advantages to be gained. The Central, it is said, in asking for the franchise to build a four-track elevated road on Eleventh Avenue, will make the claim that electricity will not give the desired safety in the tunnel, and that, therefore, the authorities ought to make it a concession which will enable it to do away with the tunnel dangers effectively. We learn, however, that the Central plans for electricity are being busily studied out.

Nernst Street Lamps in Farmington, Conn.

The Union Electric Light & Power Company, whose plant is located in the town of Farmington, Conn., is probably the first in the United States to adopt Nernst lamps exclusively for an extended system of street lighting. Unionville, the headquarters of this company, is a village in the town of Farmington, near the Farmington River, and about 10 miles from the main business section of Hartford. This village is reached from Hartford by the Farmington street railway, and is also on the line of a steam road. About two months ago the Union Electric Light & Power Company began the operation of an entirely new plant, and provided an extended system of street lighting with Nernst lamps. The generating plant of this company is driven mainly by water power, derived from the Farmington River.

The equipment comprises two three-phase generators, each with a capacity of 75 kw at 2400 volts and 7200 alternations per minute, one 27-inch horizontal turbine wheel and one steam engine of 100 hp capacity, with the necessary accessory apparatus. This machinery is housed in a new brick station of one story in height. From this station the Union Electric Light & Power Company supply public and commercial lighting in the village of Unionville and the Borough of Farmington, both of which are in the town of Farmington. Dynamos are belt connected to a shaft driven by the turbine wheel, or to the steam engine, according to the amount of available water power and the electrical load.

All energy is distributed from the station at the constant pressure of about 2400 volts, and is subsequently transformed to 224 or 112 volts constant pressure for street lighting and commercial service. For house lighting the 112-volt pressure is mostly used, but on business premises and for street lamps 224-volt lines are employed. Both street and commercial lighting are done from the same transformers and circuits, but an independent return is provided for street lamps so that they may be shut off independently of the commercial service. These independent return wires for the street lamps make it also possible to shut off all of those lamps connected to each transformer at a single point, instead of going to each individual lamp.

Nernst lamps to the number of 134 are now in use on this system for street lighting in the village and borough above named. Of these lamps, 120 have one glower each, and each consumes approximately 88 watts at 224 volts. The remaining 14 lamps are of the six-glower type, and each requires about 528 watts at 224 volts.

These street lamps are supplied from 12 transformers, located at different points about the town, and are connected to the same circuits that are used for commercial service. The greatest length of any 224-volt circuit supplying street lamps is a little less than one-half mile from its transformer. Evidently this plant at Unionville is in a position to test the practical value of Nernst lamps for street lighting on a considerable scale, and the results of its experience should be of especial interest to managers of central stations.

Electrical Engineers of the Day—XXXII.

HENRY M. BRINCKERHOFF.

Henry Morton Brinckerhoff was born at Fishkill-on-Hudson, Dutchess County, N. Y. His technical education was received at Stevens Institute of Technology, Hoboken, N. J., from which he was graduated with the class of 1890. Upon graduation he entered the employ of the Thomson-Houston Electric Company in Boston, where he was put on construction work on the West End Street Railway of that city. There he served in various capacities, commencing as lineman's helper, and occupying nearly every position in line work, car equipment and power house operation. From November, 1891, to March, 1892, he was assistant engineer in the power house of the Utica Belt Line Street Railway. From the latter date, until July 1, 1892, he was engaged as foreman in charge of car equipment for the General Electric Company in Boston and on the Coney Island & Brooklyn Railway.

He thus supplemented a theoretical college education with two years as a workman in the various branches of electric railway work, which experience Mr. Brinckerhoff considers has been of the greatest value to him in after years. July 1, 1892, Mr. Brinckerhoff began his first work in heavy elevated electric railroading. At that time he was appointed assistant electrical engineer of the Intramural Railway at the World's Columbian Exposition, Chicago. In this position he assisted in designing and installing the electrical equipment on this the first third-rail elevated road of the country, and was joint patentee with the electrical engineer, Mr. C. H. Macloskie, of special apparatus designed for this system. During the operation of the road in the summer of 1893 Mr. Brinckerhoff had charge of the car equipment, power house and other electrical apparatus.

When the Metropolitan West Side Elevated road of Chicago decided to adopt electricity the following year, Mr. Brinckerhoff was naturally selected as one of the men best fitted to cope with the problem of equipping the first large elevated road for city transportation with electricity. On Aug. 1, 1894, Mr. Brinckerhoff entered the service of this company as electrical engineer, and as such had charge of the designing and installation of the electrical equipment for that road. Mr. Brinckerhoff has continued with this company ever since, having successively filled the position of superintendent of motive power and way, assistant general manager and, finally, general manager, which latter position he now occupies.

Mr. Brinckerhoff is a member of the American Institute of Electrical Engineers and of the Western Society of Engineers.

FIG. 1.—GENERAL VIEW OF SHAWINIGAN PROPERTY.

The Shawinigan Falls Electrical Development.

IN our issue of last week an outline description of the Shawinigan Falls power plant appeared, which we are now enabled to supplement with further information, particularly relating to the hydraulic portion of the plant, contained in a paper read Jan. 27 by Mr. Wallace C. Johnson, chief engineer of the plant, before the Canadian Society of Civil Engineers.

Mr. Wallace stated that the flow of water at Shawinigan Falls is seldom less than 20,000 cu, ft. per second, or sufficient to produce under the head available more than 200,000 effective horse-powers. As the St. Maurice River, flowing in a southerly direction, comes down to within about a half mile of the Falls, its course is diverted to the west and then to the north by some islands in the center of the river. The stream on the south side of these islands is very small; in fact, at the lowest stages of the river there is very little water flowing in it, but the stream flowing round to the north of the islands is quite rapid, and, having passed Melville Island, opens into a large bay, the area of which is something like 600 acres. Approaching the Falls there is a channel 1200 ft. long, about 600 ft. wide and about 20 ft. deep. At the crest of the Falls the water flows over a natural rock dam and then down in a southerly direction over the cascade, making a fall of perhaps 100 ft., then on toward the north in a narrow gorge through which the water rushes swiftly and in which there is a further fall of 50 ft., the water emptying into the lower bay which is over 1000 acres in extent.

The location of the entrance to the canal was chosen in this rather rapidly running stream at the crest of the falls, where the water is about 20 ft. deep, for the reason that at times of rather high water, when the ice is flowing out of the river, the current is expected to carry the ice past the mouth of the canal. The canal is about 1000 ft. long, 100 ft. wide and 20 ft. deep through the solid rock. The end of the canal where it comes out at the face of the hill is closed by a concrete wall into which penstocks are connected and from which the water is led down to the power house through the penstock pipes.

The means adopted for shutting the river out of the canal at the time of construction of the upper end of it was a cribwork cofferdam. This dam was built only of sufficient height to keep the water out at the lower stages of the river, which occur in winter time, the upper end of the canal being excavated in the winter time, and a higher crib dam was placed across the canal, further down toward the forebay, remaining in place during the summer. The lower end of the canal and the forebay were constructed during the summer season following. This forebay wall is 40 ft. high, about 30 ft. in thickness at the bottom and 12 ft. at the top. On top of this concrete wall are now set up hydraulic cylinders for lifting the headgates, and on top, covering the cylinders, is a brick gate house.

The cofferdam at the outlet of the tailrace was built of timber and post construction, and of such a slope that the weight of the water on the face of the dam practically held it in place, and very little loading with stone was required, the idea being principally to secure ease of removal. When it was ready to be taken out it was necessary simply to take the planks off and the timber out, when the whole thing floated.

The process of the manufacture of aluminum in use by the Pittsburg Reduction Company (the Royal Aluminum Company) requires the use of electric current in the form of direct current at 300 volts. This current is generated by special machines and fed directly to the furnaces. As the Reduction Company desire to have the generating of this current under their control, they have leased from the Shawinigan Water & Power Company power in the form of water delivered at the power house, which they have themselves built near the Shawinigan power house.

In the power house are two pairs of inward flow turbines, each pair developing 3000 hp. These turbines both take water from the same

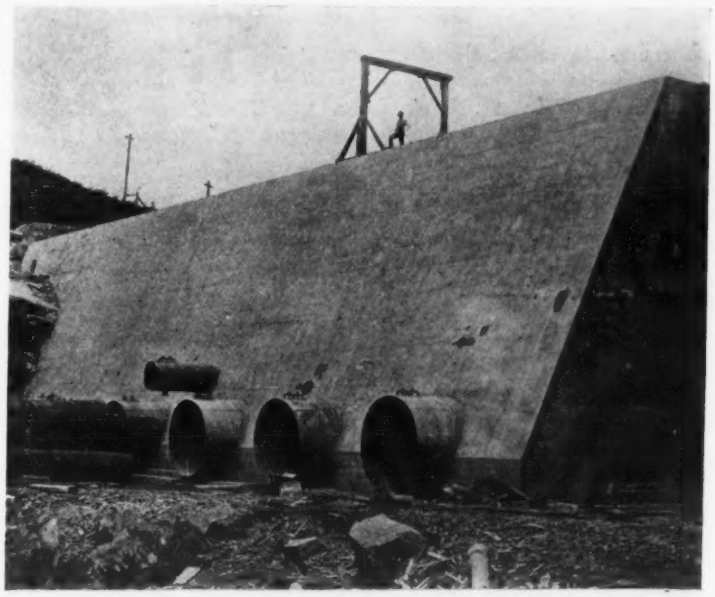


FIG. 2.—OUTSIDE OF BULKHEAD.

penstock, each of them being connected through a 78-inch valve by means of which the water can be shut out of either wheel for examination or repairs without interfering with the operation of the other pair. To each pair of turbines two 1000-kw direct-current generators are direct coupled, one on each side. From the generators the current is taken directly to the furnace room, about 1000 ft. away, by conductors made up of aluminum rods ⅜ inch in diameter.

The power house and works of the Pittsburg Reduction Company have been built with a view to their extension to accommodate three

more pairs of wheels, and a penstock opening has been provided for that purpose.

The penstocks by which the water is conducted from the forebay to the turbines are 9 ft. in diameter down to about 50 ft. from the turbines, where they enlarge to 11 ft. for the purpose of reducing the velocity of the water before it reaches the wheels. They are built up of soft steel plates, ⅜ inch thick at the upper end and increasing to 9-16 inch at the lower end. Each penstock is held against movement from expansion and contraction at the point where it passes through the wall of the power house. The wall is made 6 ft. thick at these points, and on each side of the wall, fitting closely to it, is a cast iron bracket 12 inches deep encircling the penstock and securely riveted to it. This is necessary because after passing into the power house each penstock opens into the side of the case of a pair of waterwheels.

Each waterwheel unit consists of a pair of "Francis" turbines on a horizontal shaft, capable of developing 6000 hp under a head of 125 ft. and running at 180 r. p. m. The wheel case is 16 ft. in diameter, and the distance between outside bearings is 31 ft. The runners are 6 ft. in diameter, and discharge through a central draft tube. They are made of gun-metal bronze, and the guide chutes of cast steel. The speed regulation is by means of gates in the draft tube, handled by a hydraulic governor. There is also a ring gate on the outside of the guides, by means of which the turbines will be stopped and started. This gate is operated by an electric motor, and is controlled by the operator at the controlling table on the switchboard gallery. This operator not only has the entire switchboard under his control, but all the waterwheels as well. To each waterwheel is direct connected a revolving field generator, capable of generating 3750 kw of electric current at 2200 volts, two-phase, and a frequency of 30 cycles.

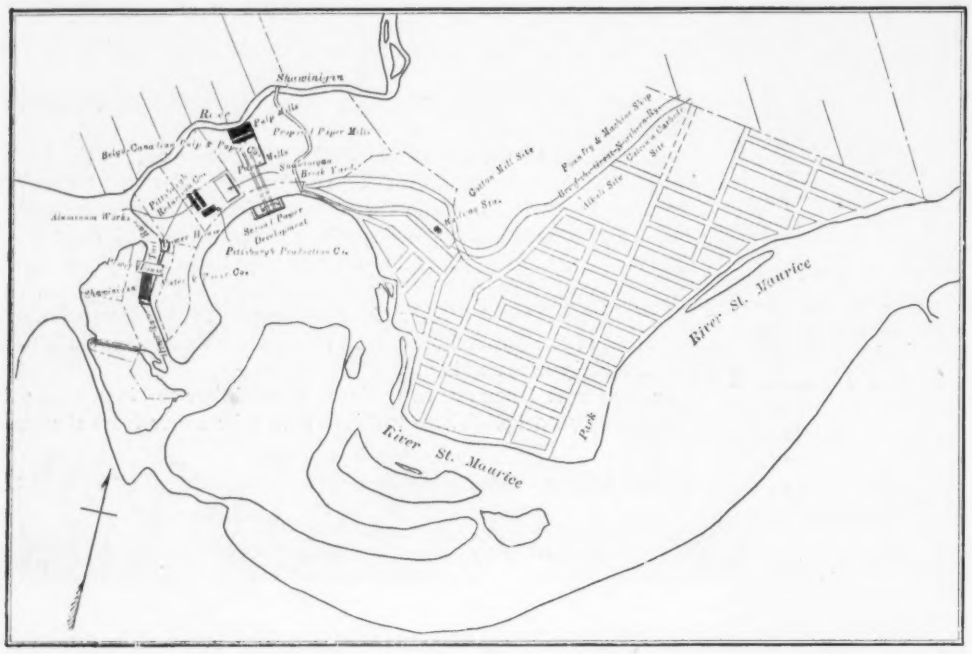


FIG. 3.—MAP OF SHAWINIGAN PROPERTY AND VICINITY.

Through a small penstock pipe water is supplied to two wheels, each of about 500 hp capacity, which will operate a direct-current generator for furnishing the exciting current for all of the generators in the power house. At present this wheel is running the machine which is lighting the buildings of the town, running our pumps and doing various other work beside furnishing current for the electric railroad and for operating the 50-ton electric traveling crane. The crane was erected in the power house before the roof, and was used as falsework on which to erect the roof trusses.

The power house will have a basement which will be below high water. On this account the lower part of the power house was built of concrete up to the window-sills, and it is expected that this will enable to be kept dry by means of a pump to take care of any leakage that may occur. The electric machinery is so arranged that it would not be disastrous to the working of the power house if the basement should be filled with water, although it would occasion some trouble and inconvenience. Above the level of the window-sills the power house is constructed of brick.

Along the bank of the Shawinigan River at its lower level is quite a tract of land, which is adapted for the building of mills desiring to use the water direct in wheels located in their mills rather than to be furnished power by electric current, and particularly for the building of paper and pulp mills. The upper part of the St. Maurice water-shed is well covered with spruce timber. About eight miles above perhaps the largest paper mill in Canada is now in operation, and something over a year ago the Shawinigan Company made a contract with the Belgo-Canadian Pulp Company by the provisions of which this company has proceeded to construct a pulp mill on this lower ground, which is now in operation, and headworks have been constructed at this point on the north side of the upper bay by which water is taken through a narrow bank and down to the mill located on the Shawinigan River. It is expected to extend the works right along to the west, and to take water out for other mills, which we hope to locate further up the Shawinigan River.

FIG. 4.—A SECTION OF PENSTOCK.

The first thing which was done in the construction of the works for taking the water to this lower mill was the building of a cofferdam. About 100 ft. out from the bank a cofferdam was built about 250 ft. long, and from each end a crib joining into the bank and pumped the inside part between the front crib and the bank out dry, and built inside the walls. This intake being built of concrete and having to be built in the summer

FIG. 5.—ONE OF THE SIX PENSTOCKS.

time the cofferdam was necessarily built high enough to take care of the high water, which occurs in the early part of the summer, and it was, therefore, located in 40 ft. of water—quite an undertaking in the way of a cofferdam.

In this cofferdam there are two openings for two penstock pipes 12

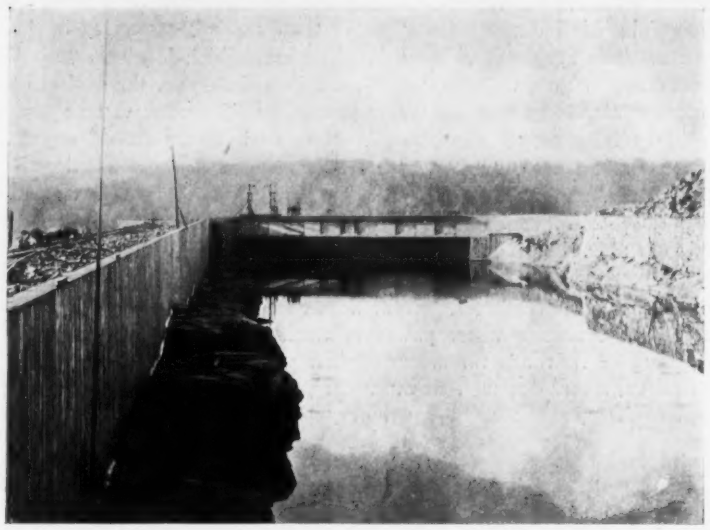


FIG. 6.—FEEDER CANAL.

Through this clay bank a tunnel was built and timbered up; the dimensions inside of the timbering being 18 ft., the penstock 12 ft.; that is, 3 ft. between the timbering and the penstock all round. This 200 ft. of tunnel through the clay bank was built without accident, and completed in one month from the time of starting the work on the tunnel. Having the tunnel completed and timbered the erection of the penstock pipe was commenced, beginning at the center. The ring in the center of the tunnel being erected first and then two rings put on to that in one direction, then concrete filled round while rings were being put on to the other side, the concrete gang going around to the other side and filling that while rings were being put on the other side.

The pipe was erected from the lower end, and the method which was adopted for supporting the penstock in this clay soil was as follows: Logs were laid close together along the trench lengthwise of it, and on top of these were cross beams supporting wooden saddles, which carried the penstock. About one-third of the way from the mill to the top of the banks, heavy anchorage of concrete was constructed, into which the penstock was fastened by means of cast iron brackets riveted around the penstock for holding it at this point and preventing any creeping due to expansion and contraction. About half way from this anchorage up to the tunnel is an expansion joint; between the anchorage and the mill are several bends in the pipe which give it sufficient elasticity to obviate the necessity of any expansion joint under the higher pressure; the expansion joint that we used being for where there is only about 25 or 30 ft. head on the pipe.

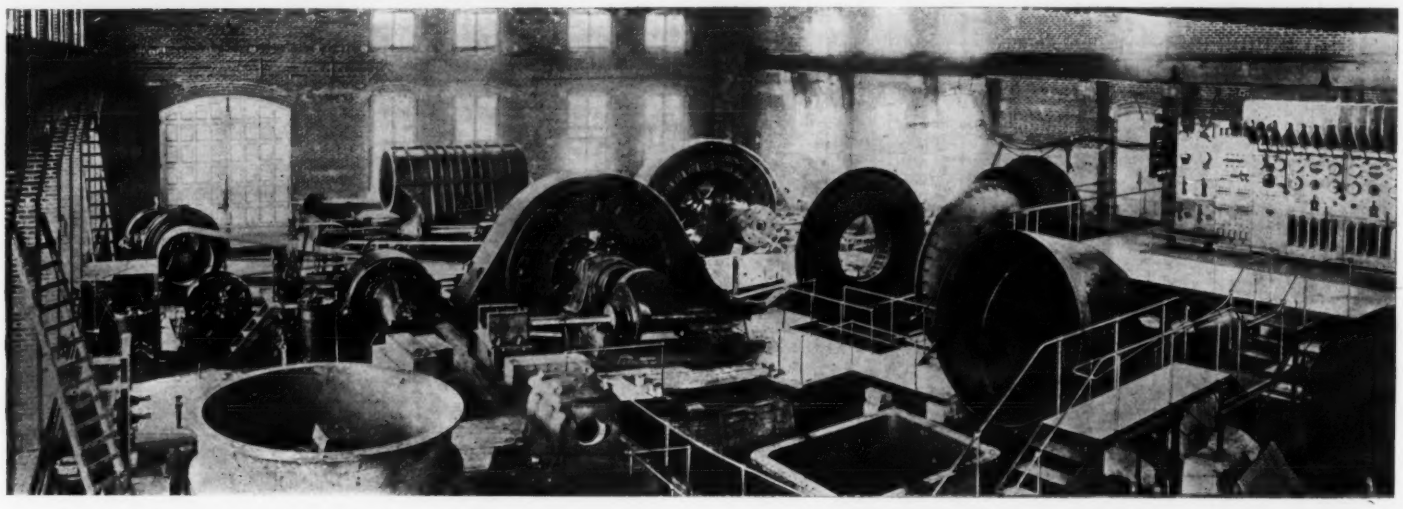


FIG. 7.—INTERIOR OF POWER HOUSE.

ft. in diameter. The steel frames supporting the racks and affording guides for the gates were built complete by themselves, so they were erected before any concreting was done on top of a grillage of steel beams and concrete forming the base of this whole structure.

This concrete wall, 40 ft. in height, was obliged to be built upon a soft clay formation. The grillage was made of such an area that the pressure at no point exceeded 1½ tons per foot, which proved entirely sufficient, there having been no settling of the work at all. The wall was built of concrete with large rocks embedded in it.

This cofferdam was made a part of the permanent work. The water is taken through the cofferdam in 10 openings, about 8 ft. square, and the cofferdam itself is left in place as a protection against the ice. Only the part back of the racks is carried up to the full height. This represents the full height to which high water is expected to go. It is carried along about 5 ft. lower for a distance, then is stepped down still lower and brought eventually so that the inner slope of earth, which is intended to run from this wall to the railroad embankment about 35 ft. above, meets this lower wall, this wall being carried up high enough to guard the bank from the wash of the water as it comes in through the openings in the crib-work cofferdam.

On each side of this wall are two cut-off walls of concrete, which are built back and well into the bank to prevent the water coming around the end of the wall. This wall was built entire, and the head gates were in and very secure, in addition to the cofferdam, before any opening was made in the bank.

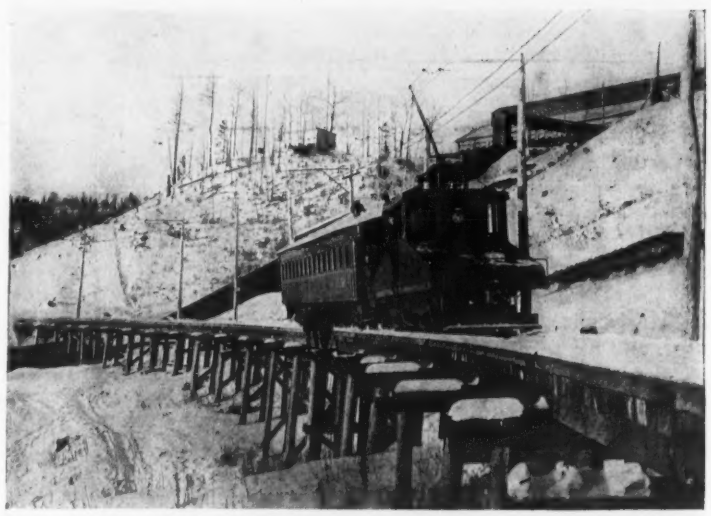


FIG. 8.—SHAWINIGAN ELECTRIC RAILWAY.

It may be remarked that incidental to the work which has been going on at Shawinigan Falls there has grown up a village of about 3000 inhabitants.

In the discussion which followed the reading of the paper, it was

asked if there are any conditions under which the penstock is likely to be emptied entirely of water, and if so, if provision has been made to prevent a collapse of the pipe. The member asking the question said he knew of a case where this occurred where the water was let out suddenly from the lower end of the pipe and the upper part closed, when the pipe collapsed for a considerable distance. It was, moreover, a very much smaller pipe than the Shawinigan pipe. In reply Mr. Johnson said that the collapse, of course, was due to the pressure of air on the outside, and that provision has been made for the entrance of air into the pipe as the gates close. In the main forebay there were five or six 12-inch pipes set into the masonry leading down to the front of the penstock back of the gates, and in the second forebay there is an opening about 3 ft. wide and some 12 ft. long, down which workmen can pass to the back of the gates and into the head of the penstock. With the penstock supported there is, of course, no danger of collapse except from the pressure of air on the outside when the penstock is empty not only of water but of air. The penstocks are often empty of air in the course of operation.

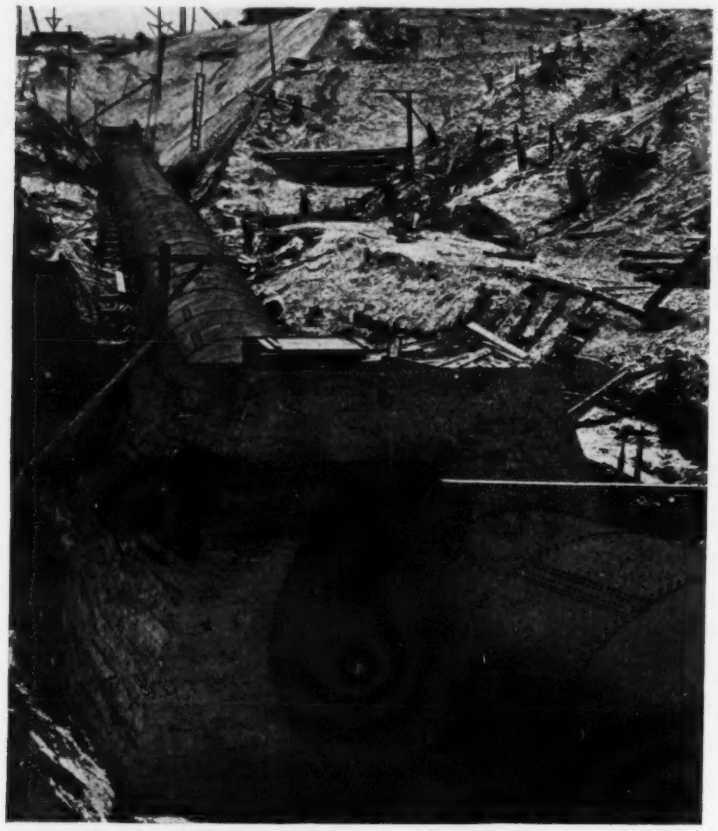


FIG. 9.—PENSTOCK FOR PULP MILL.

In reply to a question as to difficulty from ice, Mr. Johnson said that there had not been any as yet. Not much water is at present being used, but there has been no trouble whatever this winter

Replying to a question as to the power developed now, Mr. Johnson said the Pittsburg Reduction Company's power house is in operation and using 5000 hp; the Belgo-Canadian Pulp Company's pulp mill is in operation, using about 8000 hp, and the small wheel described is running in the power house. The large wheels are not yet in operation. One of the wheels is set up and about ready to start, and the other one is being set up. As to the concrete mixture used in the work, it was stated that a concrete of Portland cement has been used, and most of the proportions have been one of cement to three of sand. The proportion of stone has varied in different parts of the work. Where it was not necessary to be tight against water, as much as seven parts of stone have been used, but where it was intended that the work should be water-tight about five parts of stone were used.

New York Electrical Society.

By invitation of the New York Telephone Company the New York Electrical Society will be afforded an opportunity on the evening of Feb. 13 of inspecting the fine new "central battery" exchange at Cortlandt Street. Mr. John Carty and others will address the members.

Water Power Development in Colombia.

The Colombian Government has issued a report on the water power available in the republic. Colombian engineers have asserted that Colombia has more water power than any other country in the world. The report confirms this statement, which is abstracted in the *New York Sun*. Thus, within 20 miles of Bogota, the capital of the republic, there is more water power available than can be supplied by Niagara, the report says. Most of it comes from Tequendama Falls, near the city. These falls rank next to those of Niagara in volume, and have four times the height. More power can be drawn from Tequendama, it is said, than is at present used at both Buffalo and New York.

Colombian engineers even declare that it has been lucky for their country that railroads have never been extensively constructed there. With the immense water power at the service of the country the building of railroads for steam engines would have been labor lost. These engineers declare that the water power of Colombia is so great and so distributed throughout the republic that it can be utilized for the operation of electric roads in trunk systems even more extensively than steam power. As electric roads do not require the expensive grading and engineering that steam roads demand, it is pointed out that the loss of Colombia in the past through the absence of steam roads will be her gain in the future.

Most remarkable of all the possibilities pointed out by the Government's engineers are those connected with Bogota. This city, situated on an isolated plateau, has always heretofore been regarded as without means of progress. Owing to the steep acclivities of the plateau the building of railroads to Bogota has been declared impracticable. Now Colombian engineers come forward with a plan of not only saving the city from decadence, but of giving it better prospects than it ever expected.

At an expense of $1,000,000 they figure electric current equal to 200,000 hp can be generated at Tequendama and can be transmitted to Bogota at a loss of only 10 per cent. This vast power applied to the industries of the city will make it the most important manufacturing center on the South American continent. Electric roads to skirt the plateau of Bogota and connect with the navigable rivers can be built at a very small cost and operated inexpensively, bringing together a population of at least 300,000.

But the prosperity which would come to Colombia through the introduction of water and electric power would not be confined to Bogota. Within a radius of 50 miles from Bogota there are many waterfalls besides those of Tequendama. These falls, combined, are capable of generating as much power as Tequendama. For instance, the Magdalena River, 40 miles from Bogota Falls, in the course of 10 miles, a vertical distance of 200 ft. The great power derivable therefrom could be made to provide for the operation of electric roads for 150 miles, or far enough to connect them with other sources of power further on. To the east of Bogota, there are falls capable of generating power to operate electric roads to the Venezuelan frontier and to the head of navigation on streams emptying into the Caribbean Sea from Colombia.

But it is in the region known as the Mass of Colombia, where the great ranges of mountains come together, that the most remarkable waterfalls occur. With the exceptions of Niagara and Tequendama, these are the most valuable in the world. There, in a distance of 80 miles, the headwaters of the Magdalena River fall a distance of 7200 ft. The Cauca River descends over 8000 ft. in 70 miles without making a single precipitate plunge. It might also be said that the Mass of Colombia was upheaved in order to become the main power house of civilization. In the Mass of Colombia power can easily be developed to operate electric roads to the Pacific Ocean on the west, far beyond the Ecuadorian frontier on the south and very nearly to Venezuela on the east.

The northern part of Colombia is least provided with water power, yet it is more favored in this respect than most other regions of the world. While electric power would cost more to generate throughout Northern Colombia than elsewhere in the republic it can be obtained in quantities sufficient to supply a system of electric roads connecting the Caribbean shore with the interior. Along the Nechi River alone enough electricity could be developed to operate roads for hundreds of miles as well as mines, mills and factories.

The Wright Maximum Demand System.

BY R. S. HALE.

REFERRING to your editorial on the Wright Demand System in your issue of Dec. 28, the statement, on the whole, is so clear and accurate that I wish to correct but one or two minor but very important points. The editorial says, "There must be considerable latitude in methods for charging for electricity, and while Mr. Wright's system sometimes works well, there are cases in which it might be disadvantageous against sharp competition."

Any inflexible system is at a disadvantage against sharp competition, and if some forms of the Wright system are used as an inflexible system they may be at a disadvantage; but it should be remembered that even if inflexibly applied, they will work better than any other inflexible system, and in some cases better than any other system whatsoever. Further, if it is found necessary to use a flexible system, one that can be changed to meet sharp competition, even then it is necessary for a station manager to follow the principles of the Wright system if he wishes to get his share of the profitable business. If a station manager is working on a contract system, so much per lamp per month or per year, he can best meet competition, not by cutting his rates to all his customers, but by cutting his rates to the short-hour customer. On a contract system it is the long-hour customers who are unprofitable, and the short-hour customers who pay the station a good profit. On a contract system the station gets enough for its fixed charges from each customer, but the long-hour customer uses more coal and costs the station more without paying more. In other words, the situation is the exact reverse of a meter system. If a manager is working on a meter system he will best meet competition, not by cutting his rates to all his customers, which will increase his unprofitable business as well as his profitable, but will cut his rates by giving a lower rate per kw-hour to the long-hour customers. Or, in a word, in both cases he will follow the principles of the Wright demand system if he meets the competition in the best way. Both of these methods of meeting competition are in exact accordance with the principles of the Wright system, and any station manager who fails to follow the principles of this system will do much of his business at a loss.

It is true, as you say, that a central station like any other business concern, must occasionally accept the situation and do a certain amount of business at a loss, but the less business that it does at a loss and the more business that it does at a profit, the better will be the net return to the stockholders; and the best way to reach the happy result of getting a reasonable profit on all the business will be to follow the principles of the Wright system in making up the scale of charges.

Another sentence in your editorial is also apt to lead to much misapprehension. The sentence is, "After all, the thing which counts when the books are balanced, is the average selling price of the product, and that must be kept where it will count against competition." I fear that there may be some of your readers who will understand this to mean the average selling price per kw-hour. What a central station plant really wants to sell, however, is not kw-hours, but the use of its plant for as many hours in the day as possible. A station that sold a million kw-hours every day in the year might do it at a loss, since it might require more than a million kilowatts of plant. A central station manager may make the price per kw-hour what he chooses, and if he makes it low enough may sell a great number of kw-hours, but if such sales are to short-hour customers, who require a big investment in plant, but leave that plant idle 90 per cent of the time, he will fail to earn a profit on the cost of the plant. He will make more money if he charges the short-hour customers a higher price, and then, if his competitor underbids him, he will use the plant these short-hour customers formerly monopolized, to supply the long-hour customers who may pay him a lower price per kw-hour, but will give him a better profit on the investment. It is no use to sell kw-hours at any price whatever unless the earnings show a net income above expenses and depreciation of $4 per $100 of investment, or, say, $20 to $40 net income per kilowatt of plant (maximum demand), for the ordinary small station.

Further, it should be noted that a scale of charges based on the Wright system will in many cases automatically adjust itself to meet competition of certain classes. For instance, the office building with light on all sides, which uses very little current except a few hours in the winter afternoons, finds the cost per kw-hour of its isolated plant high, and is willing to pay a high rate to the central station. On the other hand, the building with dark offices, or the power plant that generates current ten hours a day, finds the cost of current per kw-hour of its isolated plant comparatively low, but to such customers the Wright demand principles indicate a low rate and the Wright system gives it to them.

A central station must get a net return on its investment, and practically every central station that is doing many different kinds of business, such as power, supply residence lighting and street lighting, follows the principles of the Wright system in determinng the charges to these different classes of customers.

The details of the Wright system and the use of the Wright demand indicator help greatly in applying the principles of the system, and the cost of the indicator is far more than made up by its advantages; but neither the details of the system nor the use of the indicator are absolutely necessary in all cases.

It is very important, therefore, that central station managers should appreciate that whether they buy Wright demand indicators or not; whether they make two rates or discounts for long-hour customers, or special rates to special customers, they must, nevertheless, follow the principles of the Wright system to get the best results, must develop and encourage their profitable (long hour) business to the greatest extent, and should accept an unprofitable (short hour) business only as an advertisement or as a help towards getting really good business.

Magnetic Deflection of Long Steel-Wire Plumb-Lines

BY DR. WM. HALLOCK.

IN the course of work in the very deep shaft of the Tamarack Mining Company on Lake Superior, it became desirable to plumb down two points to run off a cross cut to meet one started from another shaft. This was done in the latter part of last summer, and a very good account of the operation was given in the issue of Oct. 10, 1901, of the *Portage Lake Mining Gazette.*

The lines were of No. 24 piano wire, and the weights 50 lbs. of iron. At first they were 16.33 ft. apart at the top, but they were afterward moved to 17.58 ft. The remarkable observation was that in the first case they were 0.09 ft., and in the second case 0.07 ft. farther apart at the bottom than at the top. Naturally, the persons in charge were at a loss to explain the fact. The theory most persistently advanced was that the nearer wall pulled each bob toward it. Of course, this is not the case, for the potential in such a space is constant, and even if the attraction claimed were effective it would amount to only enough to move the bob less than 0.001 ft.

Being familiar with the very high magnetization found in the vertical casings in oil and gas wells it occurred to me that the observed deflection might be due to a magnetization of the wires and a consequent repulsion of the two north poles at the bottom. It will be remembered that the vertical component of the earth's field at Lake Superior must be about 0.9 (dip = 77 degs.), and a wire under such conditions of stretching and jarring and blending is in the best way to get magnetized.

A simple calculation will show, however, that the force of repulsion required is too great to be ascribed to a simple repulsion of the two poles at the ends of the wires, for any supposable degree of magnetization in such a wire, by such a field. It is, however, possible that the wires being not perfectly homogeneous would have consecutive poles along their length, and that these might add to the force, and, moreover, there are the masses of iron in the shaft in the way of elevators, ways, cables, etc., which would contribute one way or the other.

In order to test the possible applicability of this theory I made a number of experiments in the research shaft at Columbia University and have found much corroborative evidence.

A bar was mounted so that it could be rotated in a horizontal plane, about its middle point, and at one end a plumb line was placed which consisted of a fine copper wire carrying a non-magnetic bob. At the other end of the bar was another plumb-line, consisting of a soft iron wire about 0.02 inch diameter, with a similar bob. These plumb lines were 75 ft. long, and were about 4 inches apart, and their plane coincided with the magnetic meridian. Observation showed that the bobs were about 1-75 inch closer together when the iron was south of the copper than when it was north. In other words, the iron plumb line was pulled about 1-150 inch toward the north by the action of the horizontal component of the earth's field upon the iron wire.

The experiment was varied by taking two lines of the soft iron

wire, and measuring their distance apart at the top and bottom. Under these conditions the mutual repulsion gave a deflection of the same order as the pull of the earth's field.

Thus we undoubtedly have an effect upon the lines due to induced magnetism, but again too large to be due to a simple pole at the ends. It was consequently desirable to investigate whether there were poles along the line, and with a very small compass they were investigated along their whole length, with the following result:

Position on wire.	*South wire.*	*North wire.*	*Effect.*
Top.....	Strong south.	Strong south.	Strong repulsion.
5 ft.....	Weak south.	Weak south.	Weak repulsion.
10 "	South.	South.	Repulsion.
15 "	Weak north.	South.	Weak attraction.
20 "	North.	North.	Repulsion.
25 "	North.	Neutral.	Neutral.
30 "	Weak south.	Neutral.	Neutral.
35 "	Weak north.	Neutral.	Neutral.
40 "	North.	North.	Repulsion.
45 "	South.	South.	Repulsion.
50 " bot...	Strong north.	Strong north.	Strong repulsion.

In the plumb lines the upper 25 ft. was of copper wire, that above the point referred to as the "top," in the above table, which is for the 50 ft. of iron wire forming the lower two-thirds in each plumb line.

The conclusion is evident. Iron or steel wire ought not to be used for plumb lines where accuracy is needed, as they are deflected by the earth's field as well as by each other. Probably phosphor-bronze would prove most available where great tensile strength is needed.

A New Apparatus for Measuring the Variation of Speed of a Flywheel During One Revolution.

By E. W. Mix.

CONSIDERABLE attention has of late been called to the problem of measuring conveniently the variation of speed during one revolution of a flywheel or revolving field of an alternating-current dynamo. The apparatus described herewith is very convenient for this work. The principle is the following:

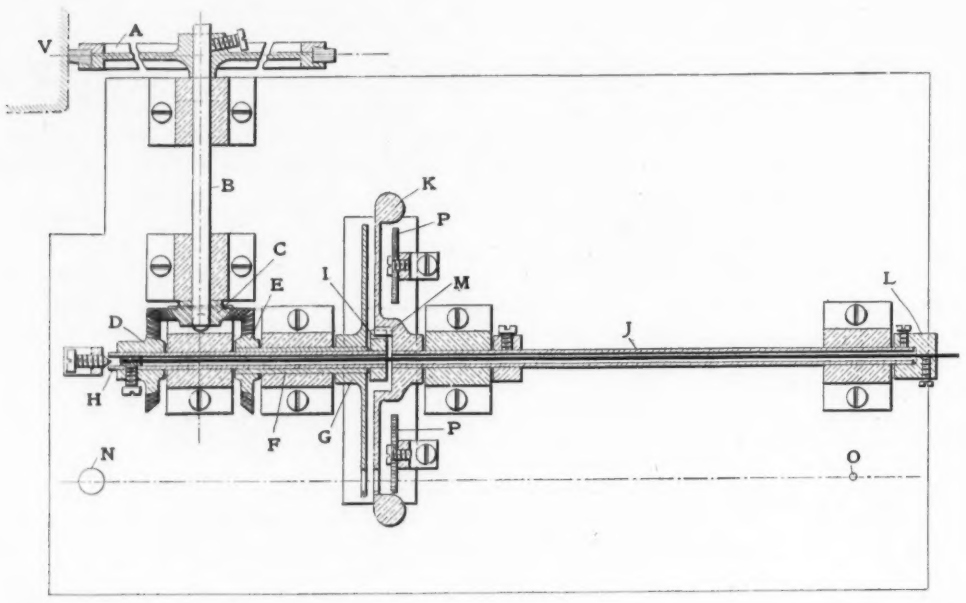


DIAGRAM OF APPARATUS FOR MEASURING VARIATIONS OF SPEED.

A small disk having considerable inertia is driven by means of a flexible coupling at a practically constant speed by means of the flywheel under observation, while a light aluminum disk is driven in the opposite direction at a speed proportional to the speed of the flywheel and obliged to follow all the variation of speed of the latter. These two disks are mounted side by side with their axes in the same line, and a radial slit is cut in each of them at the same distance from the center. When the two disks turn at exactly the same speed these two slits pass one another at the same point in space, but should one revolve faster than the other the point of passing of these slits will be displaced in one sense or the other, depending on which disk is revolving the faster.

By placing a lamp on one side of the disks and an opaque screen on the other a spot of light will be projected on this screen, and its displacement can be easily observed.

If, now, the aluminum disk be driven with an angular velocity, say, 40 times as great as that of the flywheel whose variations in speed are to be observed, and the disk with high inertia be driven by means of a flexible coupling from the same flywheel, the relation between the inertia of the disk and the flexibility of its coupling being such that the former will revolve at practically constant speed and proportionately to the mean speed of the flywheel, then the spot of light on the screen will move back and forth through an angle 40 times as great as the angular variation of speed of the flywheel. By thus multiplying the angular variations the measurements can be made with great accuracy.

The illustration herewith is made from a scale drawing of the apparatus as actually constructed. In this figure *V* represents a section of the rim of the flywheel, whose variations of speed are to be measured. The small disk or wheel *A*, made with as little inertia as possible, is provided with a rubber tire so as to be driven by friction against the rim of the flywheel. This wheel is mounted on one end of a shaft *B*, carrying at the other end a conical pinion *C* which drives two other conical pinion *D* and *E*, having an equal number of teeth.

The pinion *E* is mounted on one end of a hollow shaft *F*, which carries at the other end the light aluminum disk *G*. The pinion *D* is mounted on one end of the hollow shaft *H*, passing inside the shaft *F* and carrying at the other end a collar provided with a lug *I*. The disk *K*, provided with a heavy rim so as to give it considerable inertia, is mounted on one end of the hollow shaft *J*, the latter being mounted in line with the shaft *F*. The other end of *J* is provided with a collar *L* which can be fixed on the shaft, by means of a screw, in any angular position.

A small steel wire passes through the two hollow shafts *H* and *J*, one end being fastened by a screw in *H*, the other being held in the collar *L*. By twisting more or less this steel wire by means of the collar *L* the necessary turning moment for driving the disk *K* can be obtained. Inside the cavity in the hub of the disk *K* is a little lug *M*, which can come in contact with the lug *I* fixed to the end of the shaft *H*. By means of these two lugs the disk *K* can be brought up to speed without undue strain on the steel wire which normally drives the disk *K*.

The slits in the two disks are shown in line with the points *N* and *O*, *N* representing a lamp and *O* the eye of the observer. *P* is a ground glass circular scale divided into degrees of a circle on which the angular displacements of the spot of light produced by the passage of the slits in the two disks one before the other can be observed.

In case the rim of the flywheel under observation does not turn perfectly round it is necessary to make a flexible extension to the shaft *B* on which the driving disk *A* is mounted, so that this disk can follow the rim without being obliged to compress too much the rubber tire, as in the latter case the resultant circumference of the disk *A* would vary at different angular positions of the flywheel and so produce errors of observation of the same order as the angular variation of speed to be measured.

Should it be desired to register the variation of speed, this can be done by slightly separating the two disks *G* and *K*, and introducing between them a satellite pinion driven by two conical pinions, one mounted on each of the disks. An index carried by the axis of this satellite pinion can be made to describe a curve on a piece of paper driven before it at a uniform speed as is done in a recording amperemeter.

The National Bureau of Standards.

In a circular just issued the National Bureau of Standards gives an account of its inception and organization, and an outline of the work it is at present prepared to perform for the public.

By an act of Congress approved March 3, 1901, the Office of Standard Weights and Measures of the Treasury Department was, on July 1, 1901, superseded by the National Bureau of Standards, the functions of which are as follows: The custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

The Bureau is authorized to exercise its functions for the Government of the United States, for any State or municipal government within the United States, or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuit requiring the use of standards or standard measuring instruments.

For all comparisons, calibrations, tests or investigations, except those performed for the Government of the United States or State governments, a resonable fee will be charged. Provision is also made for the purchase of a site and the erection of a suitable laboratory, its equipment with the most improved facilities and the personnel necessary for the organization of the Bureau.

A suitable site has been selected in Washington in a locality free from mechanical and electrical disturbances, and yet easy of access. Plans are being prepared for a physical laboratory which will be equipped with apparatus and conveniences for carrying on investigations, and for testing standards and measuring instruments of all kinds. Also a somewhat smaller building, to be known as a mechanical laboratory, which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, dynamos for experimental purposes and laboratories for electrical measurements requiring heavy currents.

The construction of the buildings will be pushed as rapidly as possible, and it is expected that they will be ready for occupancy by Jan. 1, 1903. For the present, additional quarters have been secured in the building occupied by the former Office of Standard Weights and Measures, with a view to the organization of the Bureau and the immediate development of the more needed extensions of the work heretofore carried on, such as photometric measurments, the testing of instruments for determining high or low temperatures, clinical thermometers, chemical glass measuring apparatus, electrical apparatus used to measure alternating currents, pressure gauges and meteorological instruments.

For the present, however, the work of the Bureau will be limited to the comparison of the following standards and measuring instruments, either for commercial or scientific purposes:

Length Measures.—Standard bars from 1 to 10 ft., or from 1 decimeter to 5 meters; base bars, bench standards, leveling rods, graduated scales, engineers' and surveyors' metal tapes, 1 to 300 ft., or from 1 to 100 meters.

Weights.—From 0.01 grain to 50 lbs., or from 0.1 milligram to 20 kilograms.

Capacity Measures.—From 1 fluid ounce to 5 gallons, or from 1 milliliter to 10 liters.

Thermometers.—Between 32 degs. and 120 degs. F., or 0 deg. to 50 degs. C.

Polariscopic Apparatus.—Scales of polariscopes, quartz control plates and other accessory apparatus.

Hydrometers.—Alcoholometers, salinometers and saccharometers, whose scales correspond to densities between 0.85 and 1.20.

Resistances.—Standard coils of the following denominations: 1, 2, 5, 10, 100, 1000, 10,000, 100,000 ohms; low-resistance standards for current measurements of the following denominations: 0.1, 0.01, 0.001, 0.0001 ohm. Coils of resistance boxes, protentiometers, ratio coils.

Standards of Electromotive Force.—Clark and other standard cells.

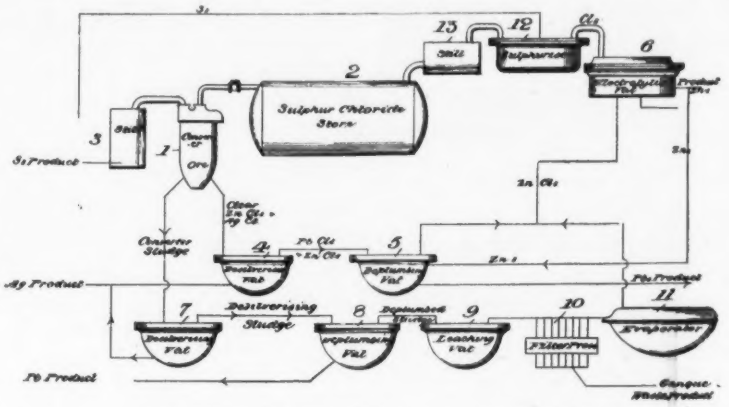
Direct-Current Measuring Apparatus.—Millivoltmeters and voltmeters up to 150 volts; ammeters up to 50 amperes.

It is the desire of the Bureau to co-operate with manufacturers, scientists and others in bringing about more satisfactory conditions relative to weights and measures in the broader meaning of the term, and to place at the disposal of those interested such information relative to these subjects as may be in possession of the Bureau. All communications and articles should be addressed "National Bureau of Standards, Washington, D. C."

Reduction of Complex Sulphide Ores.

A patent to James Swinburne and Edgar Arthur Ashcroft issued under date of Jan. 28, relates to a process designed for the treatment of those complex sulphide ores which have so long proven a stumbling block to metallurgists. The process is cyclical in character and simple in theory. Its chief novelty lies in the use as a chlorinating agent of chloride of sulphur, S_2Cl_2, applied in gaseous or liquid form to unroasted sulphide ore held in suspension in fused chloride of zinc.

The accompanying diagram will render clear the operation. The ores, for example, the Broken Hill sulphides carrying zinc, lead and silver, are held in suspension in molten chloride of zinc in the vessel 1, while chloride of sulphur is injected from the drum 2. The reaction, which is said to proceed readily, yields sulphur which is condensed in the "still" 3; mixed chlorides of the metals, which, after purification from iron and manganese, are desilvered in the vat



APPARATUS FOR REDUCTION OF SULPHIDE ORES.

4 by lead, deplumbed in 5 by zinc, and passed, still molten, to the electrolyzer 6; and a sludge consisting of the ore gangue mixed with molten chlorides. This sludge is desilverized and deplumbed in vats 7 and 8 by successive treatments with lead and zinc, and the resultant zinc chloride leached from the gangue, filtered, and evaporated with the addition of an alkali metal chloride, the resulting anhydrous double chloride of zinc and the alkali metal passing also to the electrolytic tank. Here the fused salt is electrolyzed with insoluble anodes, the zinc being collected, and the chlorine utilized in the "sulphurizer" 12 for the production of further quantities of the chloride of sulphur. This chloride, condensed at 13, returns to the reservoir 2, thus completing the cycle.

The process is thus regenerative in character, yielding zinc as pure metal, silver as a rich bullion, lead as metal or in alloy with zinc and sulphur. Concerning the velocity of the initial reaction and its completeness, no definite or satisfactory information is given, and these are crucial points.

Chicago Telephony.

Chicago druggists who have had the automatic dime-in-the-slot telephone pay stations in their stores for the benefit of the public are raising a protest against the nickel-in-the-slot party-line telephones which are being installed in such great numbers all over the city, as the nickel-in-the-slot business is said to be lessening the income of the dime telephones with a consequent reduction of druggist's commission. The druggists object to a discrimination of 5 cents against the individual circuit telephone in their stores, claiming that the majority of people do not care to pay 5 cents extra for the privilege of talking over an individual in preference to a party-line telephone.

The Economic Design and Management of Telephone Exchanges—VII.

By Arthur V. Abbott, C. E.

III. DETERMINATION OF THE TELEPHONIC CENTER.

THIS demonstration of the preceding article gives rise to a very facile method for ascertaining the telephonic center for any given city. On any fairly good map, plot the location of existing or prospective subscribers. Find the total number thereof, then place a ruler parallel to one of the prevailing street directions, and move it over the map till it has crossed one-half the number of subscribers. A line drawn by the edge of this rule will be one axis. Place the rule at right angles to the first line and repeat the process, obtaining the second axis, with the telephonic center at the intersection of the two. To illustrate this method, refer to Fig. 3, in which

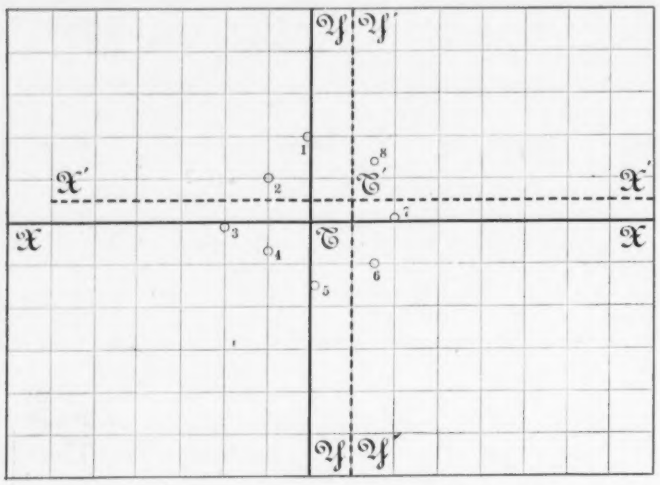


FIG. 3.—DETERMINATION OF TELEPHONIC CENTER.

the small black circles represent groups of subscribers. One subscriber is assumed to be placed at each of the points 1, 2, 3, 4, 5, 6, 7 and 8, but the reasoning is the same for any number of subscribers at these points. Assume the lines of the section paper to represent the prevailing direction of the streets. Then, by the preceding rule, the line *Y T Y* must be drawn parallel with the lines of the section paper, and in such a location as to place four subscribers on the right hand of it, and four on the left hand. Similarly, the line *X T X* must be drawn at right angles to *Y T Y*, and at such a location as to place four subscribers above the line and four below it. Then *T* is the telephonic center, *Y T Y* and *X T X* are the axes, shown in full black line in the figure, and the sum of the perpendicular distances from *Y T Y* and *X T X* to 1, 2, 3, 4, 5, 6, 7 and 8 is less than the sum of the same distances to any other pair of lines that can be drawn parallel to the section paper lines.

In this illustration subscribers 1 and 5 and 3 and 7 are supposed to lie infinitely near the axes of *Y* and *X*, respectively, but on opposite sides of these lines, so that if either line were moved slightly in either direction it would pass across one subscriber. Now, suppose the axis *Y* to shift parallel to itself one unit, say, to the right, then the perpendicular distances to subscribers 1, 2, 3, 4 and 5 will be *increased* one unit each, and the distances to 6, 7 and 8 will be *decreased* one unit each. There will, therefore, be a total gross increase of five units, and a decrease of three units or a net increase of two units to the total mileage of all subscribers from this axis. Assume that the amount that the axis is shifted *decreases* till it is equal to the smallest assignable quantity, then the net increase in mileage will correspondingly decrease, but it is evident that so long as the motion of the axis is greater than zero the increment to the mileage will be a positive quantity greater than zero, hence the position *Y T Y* gives a minimum mileage. The same reasoning may be applied to the position of *X T X*, thus proving that *T* is the telephonic center. In Table 2 the perpendicular distances of the subscribers from the axes, in terms of the ruling of the section paper as a unit, is given both for the location through the telephonic center and a new location at X^1 T^1 X^1 and Y^1 T^1 Y^1, shown in dotted lines. In this example the *Y* axis was shifted ten divisions of the section paper, and the *X* axis five. The resulting increase in mileage is 30 units, but if the motion of either axis is varied in any amount, it is easy to see that the mileage increment will be proportionally changed.

TABLE II. COMPARISON OF WIRE MILEAGE FOR FIG. 3.

Subscriber's number.	Distance from. $Y\ T\ Y$	$X\ T\ X$	$Y^1\ T^1\ Y^1$	$X^1\ T^1 X^1$
1	0	19	10	14
2	9	9	19	4
3	19	0	29	5
4	9	6	19	11
5	0	14	10	19
6	14	9	4	14
7	19	0	9	5
8	14	13	4	8
Totals	84	70	104	80
		84		104
Total distance from axes		154		184
				154
Increase				30

If there are an uneven number of subscribers in the territory the preceding rule of drawing the axes in such a manner that numerically one-half the subscribers lie on each side of each axis still holds true. For, in order to place an *equal* number of subscribers, one *each side* of *each axis*, each axis must pass *through* at least one subscriber. When a subscriber is located *on an axis* the *distance* from that axis to the subscriber becomes zero, and the function of x or y, as the case may be, vanishes, and in so far as the axis under consideration is concerned the subscriber vanishes, and thus the condition of (Eq. 22) holds true for those that remain, requiring one-half the *balance* to be placed on each side. To illustrate, turn to Fig. 4. As-

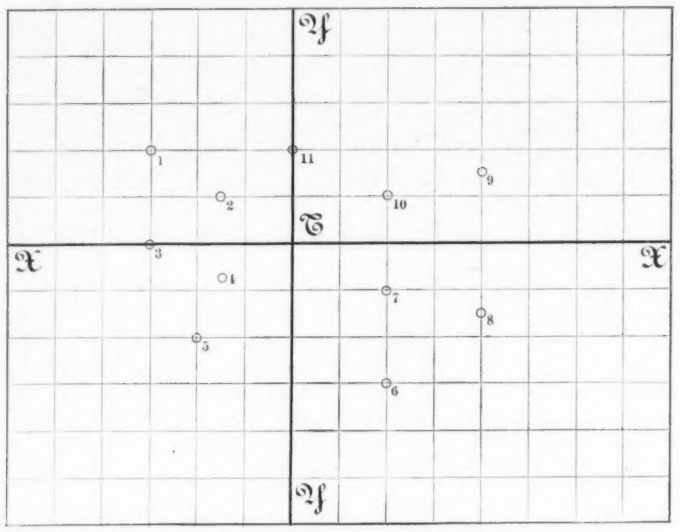


FIG. 4.—DETERMINATION OF TELEPHONIC CENTER.

sume the plane of the paper to represent any territory, and the black circles numbered from 1 to 11, inclusive, to stand for the subscribers, one at each point, and that the section paper lines coincides with the general direction of streets. Enumerating the subscribers 11 are found. To locate the line *Y T Y*, so that there shall be an equal number of subscribers on each side of and parallel to the section lines can only be done by drawing it to pass through No. 11. *X T X* must be drawn perpendicularly to *Y T Y*, and so situated as to place half the subscribers above the line and half below it. This can only be done by drawing it through No. 3, and the telephonic center is found at the point *T*. In this illustration the ordinate of No. 11 is 20, using the squares of the section paper as units, and the abscissa 0, and for No. 3 the ordinate is 0 and the abscissa 30. Now, by reasoning in a similar manner to that used in the preceding example it is easy to see that if either axis, say, *Y T Y*, be shifted, say, one unit to the right and abscissæ to Nos. 1, 2, 3, 4, 5 and 11 will be *increased* one unit each, while the abscissæ to No. 6, 7, 8, 9 and 10 will be *decreased* one unit each. Hence there will be a gross *increase* of six units and a gross *decrease* of five, or a net increase of one unit. The same argument applies equally to the other axis. So the shifting

of either by any assignable quantity in either direction causes a positive increase in the sum of all the perpendicular distances of the subscribers from the axes.

It is now desirable to consider the application of this method to such distributions of subscribers as are commonly encountered, together with some special cases that are of interest. In Fig. 5 is given an example of the solution of the problem of finding the telephonic center under conditions that probably most frequently ob-

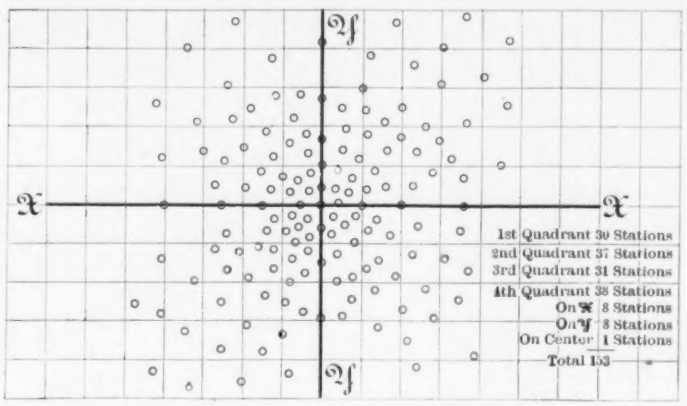


FIG. 5.—DETERMINATION OF TELEPHONIC CENTER.

tain, that is, a group of subscribers distributed over an approximately circular area in which the subscribers' density, or number of subscribers per unit of area, is greatest at about the center of the territory, and decreases with sensible regularity in all directions toward the circumference. In all the following examples the section lines indicate the prevailing directions of the streets, and consequently that of the axes, while the small circles represent the subscribers. In this case there are 153 subscribers, and according to the preceding principles the axis *y* must pass through one subscriber, and put 76 on the left hand and 76 on the right hand. On trial, however, it is found that the nearest approximation that can be made is to draw *Y* through nine stations, leaving 144 to be divided between the two sides, and the line is so located as to place 72 on each side of it. The axis of *X* is located in a similar manner. After the axes are drawn, it seems that there are thirty stations in the upper left-hand quadrant, five on the axis of *y* above the axis of *x*, 37 stations in upper right-hand quadrant, four stations on *x* to the right of *y*, 31 stations in the lower right-hand quadrant, three stations on *y* below x, 38 stations in the lower left-hand quadrant, four stations on *y* to the left of *x*, and one station at the telephonic center.

Take the distribution illustrated in Fig. 6. Here the stations fall

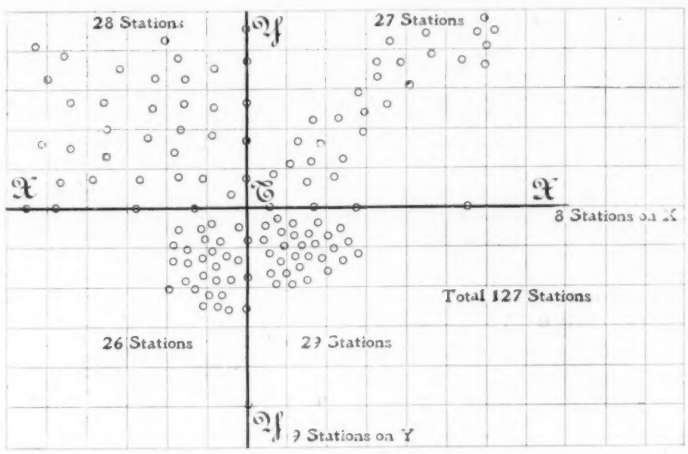


FIG. 6.—DETERMINATION OF TELEPHONIC CENTER.

into four irregular lots—two small compact groups, and two in which the density is low, one nearly rectangular in outline and the other long and linear. There is a total of 127 stations. The nearest approximation that can be made is to draw *y y* so as to cut nine stations, putting 58 on the left side and 60 on the other, and *x x* to cut eight stations, placing 60 above this axis and 59 below, giving the telephonic center *T* at the intersection of the two lines. To test the correctness of this location, suppose *y y* to move one unit to the right, then the distance to the 58 stations to the left will be increased one unit. As the axis has moved one unit away from the nine stations that it previously cut, the mileage to each of them will be increased one unit, or there will be a total increase of 67 units. The motion of the axis will be toward the 60 stations on the right of it, hence there will be a decrease of 60 units on this side, or a total net increase of seven units. In the same manner, it is easy to see that if *x x* moves one unit, say, upward, there will be an increase of seven units. Hence, neither line can move any assignable quantity without increasing the mileage.

When, therefore, such considerations as are thus illustrated are taken into account, the rule for locating the telephonic cetner is as follows: Draw a line through the group of stations parallel to one of the given directions, at such a location as will place as nearly as possible half the subscribers on one side and half on the other. Draw a second line perpendicular to the first at such a place as will again place as nearly as possible half the stations on one side thereof and half on the other. The telephonic center is at the intersection of the two lines.

Switch Operated by Compressed Air in the United States House of Representatives.

During the last few months the House of Representatives, at the National Capitol, Washington, has been equipped with an entirely new ventilating and heating system consisting of a number of large steel fans driven by electric motors and new steam coils, controlled by the system of temperature regulation, installed by the Johnson Electric Service Company, of Milwaukee. Wis. This system con-

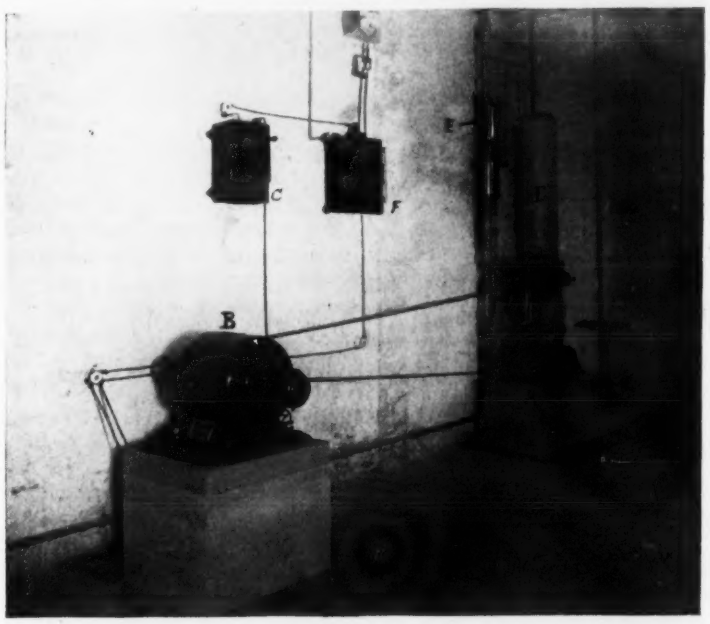


FIG. 1.—MOTOR-DRIVEN AIR COMPRESSOR..

sists, essentially, in controlling steam valves and dampers through the means of thermostats located in various places in the House wing of the Capitol, using compressed air as the motive power. A pressure of about 15 lbs. of air is sent to the thermostats. By means of expansion or contraction of the two metals of which the thermostat is made, the compressed air is controlled, and is of sufficient force to move any valve or damper of whatever size. The compressing plant is shown in Fig. 1, in which *A* is a power air compressor of neat design, placed on a solid cement concrete foundation. This compressor is unique, in the sense that the cylinder is oscillating on center trunnions, these trunnions being hollow, so that the incoming air with that which has been compressed passes out through the trunnions. Compressor *A* is connected by a belt to a series-wound motor *B*. The motor *B* has a normal speed of 600 r. p. m., which low rate in so small a motor is secured by winding a large frame to half its normal rated horse-power. This becomes necessary, as an air compressor cannot be properly operated at too high a speed, and a reduction of speed from a motor through a series of belts would be impracticable in many ways.

C is a speed regulator for the motor. The air after being com-

pressed, is stored in the cylinder *D*, from which it is supplied to various parts of the building as required.

E is a supplementary hydraulic air compressor which may be used in an emergency. Another unusual feature of the air compressing plant is the governor *F*, which is shown in more detail in Fig. 2. A normal air compressor, from 13 to 15 lbs., is necessary for operating the various heating appliances. There must be, therefore, some means of stopping and starting the motor or a safety valve for releasing the air above normal pressure. The latter method would be wasteful, since the motor would be running continuously at full load. In order to prevent this, the governing apparatus *F* has been provided. *G* is an air pipe leading from the reservoir *D*, and connected to a peculiar pneumatic apparatus enclosed in *H*. When the pressure of 15 lbs. is reached, this pressure enters the chamber *I*, and pressing down

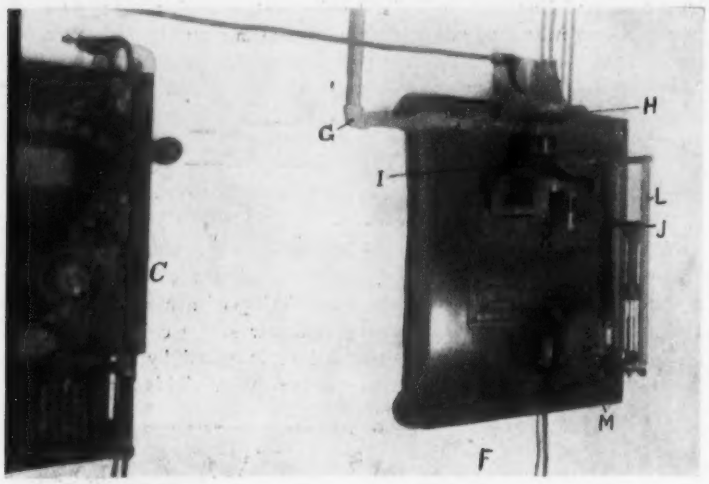


FIG. 2.—COMPRESSED AIR ELECTRIC SWITCH.

upon the lever *J*, through the means of a diaphragm *K*, expands the retractile springs *L* and opens the rotary switch *M*, thus stopping the motor. When the pressure in the reservoir *D* falls to 13 lbs. per square inch, the pneumatic mechanism in *H* exhausts the air from the chamber *I*, relieving the pressure on the lever *J*. The retractile springs *L*, then throw the switch in the opposite direction and close the circuit. This rotary switch is four-poled, and the movements which it makes, both in closing and opening circuits, are instantaneous, hence no burning at the poles can ever occur. The apparatus is very compact, entirely automatic, and in operation is nearly noiseless. It can be seen at a glance that the field of usefulness of this governor is a wide one, especially in plants using a number of compressed air valves for regulating purposes.

A Report Against Municipal Ownership at Worcester, Mass.

At Worcester, Mass., a report of the joint standing committee on street lighting against the proposed plan of municipal ownership has been filed with the city council. After investigating the conditions in many other cities, the committee found a certainty of increased cost over the present contract rate, if municipal ownership were adopted, and recommended that it was not expedient to establish a city electric light plant. The committee asked the following 29 questions:

1. Date of installation? 2. Original cost of plant? 3. Cost of plant to date? 4. Was the plant paid for by bonds? 5. What interest is paid? 6. What part of above investment is used for street lighting purposes exclusively? 7. Number of street lights used in 1900? 8. How many hours did they burn? 9. What candle-power are the lamps? 10. Are they open or closed arcs? 11. What motive power is used at your station? 12. What fuel? 13. Price of coal per ton of 2200 lbs.? 14. What did your street lights cost per lamp during 1900? 15. Does this cost include any expense outside the station? 16. If so, what items? 17. Does this cost include interest on bonds? 18. If so, what amount? 19. Does this cost include any depreciation? 20. If so, what amount? 21. Does it include anything for taxes lost? 22. What is the tax rate in your city? 23. Is the electric lighting plant run in connection with any other city department? 24. If so, how is the cost of maintenance divided? 25. Was your city lighted by electricity previous to the installation of your own plant? 26. How many lamps were furnished under contract? 27. What price was paid per lamp-year? 28. What candle-power were the lamps? 29. How many hours per year did they burn?

The resultant report in full is as follows:

In considering the subject matter under this order, your committee has endeavored to discover, first, the results attained by cities already owning municipal electric light plants, as shown by their cost per lamp-hour of street arcs; and, second, the probable cost to the city of Worcester of the plant of the Worcester Electric Light Company and the cost of maintaining this plant under municipal control.

As the cost of fuel, hour of burning and electric energy used in the lamps differ in nearly every city, as the items of interest paid on account of the plant, depreciation of machinery, etc., and of taxes lost, are usually ignored in the printed reports sent out from these plants, and as it is necessary to figure these costs upon a Worcester basis, in order to reach an intelligent conclusion in comparing the results arrived at in other cities with our own, your committee caused blank inquiries sent to 50 cities and towns owning and operating municipal lighting plants, outside the state of Massachusetts (see above).

The territory covered by these inquiries included practically the entire United States, and the replies were expected to clearly indicate the local conditions and cost of street lighting in the municipal plants of this country.

Unfortunately for this purpose, 17 cities only replied to the questions asked; of these 17, the replies received from nine were so incomplete as to render the data of no value, leaving only eight plants, outside the State, the data from which were sufficient as to be of use in making this report.

The cost of street lights as reported by these eight cities, plus the difference in cost of coal in these cities and in Worcester, plus the items of interest paid, depreciation and taxes lost (which were omitted in every case), show the average cost per lamp-hour would be 3.4 cents if the plants were located in this city and burned on our schedule.

Inasmuch as the price paid by this city for street arcs is 2.8 cents per lamp-hour, or .6 cent cheaper than the cost of the same light, burned under equal conditions, in the municipal plants outside the State, your committee took up the municipal plants within the State.

Massachusetts cities and towns owning their own lighting plants are obliged to keep their books according to a system adopted by the State Board of Gas and Electric Light Commissioners and to charge items of expense to the general account designated by the board.

This system is identical with that prescribed by the board for the companies, and affords the only correct basis of comparing the costs of the municipal plants and the companies.

The average cost per lamp-hour of the street arcs furnished by the municipal plants in this State, as shown by the reports of the board is 4.34 cents, while the price paid in this city is 2.8 cents per lamp-hour since July 1, 1901. It must not be forgotten that, with two exceptions, the municipal plants in Massachusetts burn a 300-watt lamp, while we use a 500-watt lamp in this city.

Adding the cost of coal necessary to produce a 500 instead of a 300-watt lamp, the cost per lamp-hour would be increased from 4.34 to 4.58 cents, a sum very nearly double that now paid for street lights.

It is undoubtedly true that the cost of street lights in the cities of this State, operating municipal plants, is largely affected by the amount of commercial business done by the plant, as a large deficit in commercial operation adds to the original cost of the street lights, while a small deficit, in commercial lighting, correspondingly lessens the cost of the street service.

It is also true that the condition and amount of commercial business in this city would be more favorable to the success of the plant than in many cities of the State, for the reason that the commercial business taken by the city, with the plant of the Worcester Electric Light Company, is relatively greater, when compared with the street lighting, than that done by many municipal plants noted.

In Taunton the ratio seems to be very nearly equal to that in this city.

Taunton has 227 street lights and the equivalent of 5946 16-cp commercial lamps, while Worcester has 700 street arcs and a commercial business of 19,000 16-cp lamps.

From data supplied this committee by the officers of the Taunton plant, the following facts appear:

The plant was purchased July 1, 1897, at a cost of $125,000. The

investment in the plant to date amounts to $151,000, $26,000 having been added during 3½ years.

They have 227 street lights of 1200 cp, burning 3400 hours per year, the reported cost of which is $72.96 per lamp-year. Reducing this reported cost to Worcester basis as regards the price of coal, adding taxes lost and the additional coal necessary to burn 2000 instead of 1200 candle lamps, the cost per lamp-hour would be 2.85 cents, as against our price of 2.8 cents, and it is no secret in electrical circles that the city of Taunton will soon be obliged to spend at least $50,000 on their plant, in order to bring it up to the duty required of it.

The additional requirements for interest, etc., made necessary by this investment, will increase the cost of street arcs in Taunton to 3 cents per lamp-hour.

That the consideration of this matter of municipal ownership is not new to the cities in this State, but has been thoroughly investigated by business men from a business point of view, is shown by the action of the city of Boston.

After a thoruogh investigation of the matter during Mayor Matthews' administration, in which several estimates of both cost and maintenance were made, a contract was made by Mayor Quincy for 10 years' service on a sliding scale ranging from 35 cents per light per night for 2749 lamps to 30 cents for 5000 lamps, all lights to use 500 watts energy and to burn, as in this city, 3900 hours per year.

The town of Brookline, too, after careful inquiry into the probable cost of electric street lights under municipal ownership, conducted by experts of the highest standing, contracted for 500-watt lamps burned 3900 hours per year, costing 35 cents per light per night.

The city of Springfield investigated the subject of municipal ownership; and, after careful consideration, renewed its contract with the local company.

On the other hand, the town of Hudson acquired its electric light plant under the law, and their cost per lamp-hour, for the lights used on their streets, is more than three times that paid in this city.

The experience of the town of Wakefield has its lesson, according to data furnished this committee by the municipal plant of that town, the price formerly paid under contract was $75 per lamp-year for 1200-cp lamps burning 5½ hours per night. Their plant was established in 1894 at an original cost of $164,000. The investment in the plant to date is $180,000. They use 1200 candle lamps burning six hours per night, and the reported cost is $74.68 per lamp-year. The town, plainly, loses the taxes formerly paid by the corporation, which amounts to $12.14 per lamp-year, making their true cost $86.82 per lamp-year with the municipal plant, as against $75 per lamp-year under contract, the burn being practically the same.

It has been noted that the local conditions in Worcester are different, in some respects, from those existing in many cities of the State where municipal plants have been established.

The really important point, then, is the probable cost of acquiring the Electric Light Company's plant and the cost of operating it when it is acquired.

The exact wording of the paragraph of Chapter 370, Acts of 1891, which fixes the value of plants taken, is:

"And the price to be paid therefor (i. e., the existing plant) shall be its fair market value for the purposes of its use, no portion of such plant to be estimated, however, at less than its fair market value for any other purpose, including, as an element of value, the earning capacity of such plant based upon the actual earnings being derived from such use at the time of the final vote of such city or town to establish a plant and also of any locations or similar rights acquired from private persons connected therewith."

Your committee have been unable to obtain a construction of this paragraph from the City Solicitor, and, after careful consideration and consultation with several parties of practical experience in transactions of this sort, can see no other fair interpretation of the above quoted statute than that the probable value of the plant is indicated by the market value of the company's stock at the date of the final vote in favor of the taking, as the investing public take all the elements of value named in the statute into consideration in naming the price which they are willing to pay for shares in the company. In this case, the stock of the Worcester Electric Light Company is worth at least $210 per share, that being the price at which the last issue sold in open market. The company is capitalized for $600,000, and has no bonds outstanding.

This makes the property worth, according to the judgment of investors, $1,260,000, which is the minimum amount the city would probably be obliged to pay for the plant if taken under the statute.

The legal requirements for interest, sinking funds and depreciation aggregate 12 per cent of this amount or $151,200 per year, as the minimum of fixed charges which must be earned under municipal ownership.

As the city can work their men only eight hours per day, and the company calls 10 hours a day's work, it would be necessary to add at least 25 per cent to the present pay-roll of the company.

The city certainly cannot, under these conditions, operate the plant more cheaply than the corporation has been able to do.

Taking then the running expenses of the plant under its present management as a very conservative basis for estimate, we find that the running expenses of the company last year, exclusive of dividends and depreciation, with no interest to pay, was, in round numbers, $124,000, to which add the $151,200 required for sinking funds, interest and legal depreciation, making a total of $275,200, which it will cost to operate the plant under municipal control.

The total business of the company last year, including the amount paid it by all the city departments, amounted to $236,000 only, showing that the entire business of the company was $39,000 less last year than the amount needed to operate the plant and pay the legal charges upon it under municipal control.

If, following their usual custom, the State board charge the deficit in commercial operation to the cost of the street lights, the cost of the street lighting service, in the event of this city's acquiring the Electric Light Company's plant, will be increased from $79,000 to $118,000 per year for the electric lights alone; the cost of the arcs will advance from $109.50 to $168 per lamp-year and from 2.8 cents to 4.95 cents per lamp-hour.

No reference is made in the foregoing calculation to the taxes now paid by the company into the city treasury, adding not less than $8,000 per year to the deficit already noted.

Your committee believe that the same conditions and reasoning apply with equal force to the property and business of the Gas Light Company.

This company is capitalized at $500,000, and has assets according to their last report, $733,000. Their stock is worth not less than $225 per share on the market, thus making their property too valuable for us to acquire under the statute.

As the result of the foregoing investigation, your committee recommend that it is not expedient for the city of Worcester to exercise the authority conferred in Chapter 370 of the Acts of 1891 and Acts in Amendment thereto, in the matter of acquiring a municipal electric light plant.

Automobile Industry in France.

Mr. Thornwell Haynes, U. S. Consul at Rouen, France, states that it is estimated that outside coal mining and the large metallurgical industries, automobilism, directly or indirectly, maintains more people in France than any other industry. All the factories have tripled their output during the last three years, and manufacturers formerly making cycles now produce automobiles. At first, Paris was the only city where autos were made, but now Lyons, Bordeaux, Marseilles, Lille, St. Etienne, Nantes and Rouen have factories to supply local demands. Mr. Leon Auscher, in one of the Paris journals, mentions the following branches that are benefited by this industry: Foundries for the production of cylinders and other castings; copper boiler works, factories for oilers, tubes, connections, etc.; aluminum foundries, which work exclusively for the automobile industry; spring and spindle works, whose output has increased fivefold since 1898; factories for bolts, screws, rivets and other small hardware; wheelwrights' shops, which depend in a certain measure on automobile factories; india rubber factories; nickel and copper shops; aluminum carriage building trade and allied industries; automobile painting trade; automobile upholstery trade, which employs morocco-dressed cowhide to such an extent that the French tanyards can meet the demand, and English and German products are also used; lamp trade, which furnishes two and sometimes five lights for each vehicle; the small industries allied to the carriage building trade —the leather worker, the enameler, the cabinetmaker—all contributing certain details before any single vehicle is complete; accumulator factories; specialties in measuring apparatus, ampere meters, voltmeters, resistance measurement apparatus, etc.; manufacturing, rectifying and canning automobile mineral fuel and preparing cans of

oil and non-liquid grease. "By reckoning all these workmen," adds Mr. Auscher, "a grand total is obtained of nearly 200,000 persons in France dependent upon automobilism."

The following is also worthy of note: "The use of the motor car has during recent years made such strides in France that it has given rise to a more important and ever-increasing industry. Thousands of mechanics are now employed in the construction of motors, cars and their component parts, and it is not too much to say that France is ahead of any other country in this line of manufacture. The consequences of this industry are also far-reaching, owing to the numerous subsidiary industries which it either creates or fosters." These remarks are from the report of Mr. A. P. Inglis, British Consul General, in a report on the trade of France issued by the Foreign Office. He illustrates the growth of the motor industry by pointing out that the race which was run last year between Paris and Berlin brought orders to French firms valued at 108,000,000 francs.

Canadian Niagara Power Development.

Vice-President W. B. Rankine, of the Canadian Niagara Power Company ,announces that the company has awarded the contract for the construction of the big wheel pit and the intake canal, in the Queen Victoria Falls Park, to the firm of Dawson & Reilly, of St. Catherines, Ont. This contract involves the expenditure of over half a million dollars. The wheel pit will be 175 ft. long, 160 ft. deep and 20 ft. wide. It will parallel the river, and the intake canal will be some 600 ft. wide, bringing the water direct to the penstocks in the wheel pit. Arrangements are making for the proposed power transmission line to Toronto and cities en route, a bank of 11 transformers having been ordered from the Canadian General Electric Company. The company can be ready to supply power for this transmission by October of the current year, temporarily securing current from the Niagara Falls Power Company on the American side. The 10,000-hp generators for the Canadian plant are to be made by the General Electric Company, as noted in our last issue.

The Toronto City Council proposes to petition the Ontario Legislature for special legislation to empower it to engage in the power business on its own behalf, with a view to supplying electric power to the public at a minimum price. It is proposed that the city construct and own a line of wire from Niagara Falls, or other point within a radius of 150 miles of Toronto, for the purpose of bringing electric energy to the city. The election of Colonel H. M. Pellatt and Mr. Frederick Nicholls to the directorate of the Toronto Railway Company, is regarded as an important step in the direction of the establishment of a community of interest between the three big electric concerns of the city of Toronto, which now have interchangeable directors. They can work together towards the securing of a common power supply, which will eventually come from Niagara Falls. It is admitted that such an ultimate consummation is now in view. It is possible that the three local companies will form a fourth and separate company for the object of bringing electric power from the Falls for their own use and for sale. The Niagara Power Company will likely be interested.

Electric Light Plants in Nicaragua.

Mr. Chester Donaldson, United States Consul at Managua, Nicaragua, writes:

The Government of Nicaragua has granted to Mr. T. M. Solomon, an American citizen, and Mr. J. Santos Ramirez, a Nicaraguan, a concession for installing electric-light systems at Managua, Masaya, Granada, and Leon.

Managua is to be the first city lighted. The motive power is to be steam. Meanwhile, the concessionnaires will construct a dam to utilize the water power of Tipitapa Falls, where a plant sufficient to supply the needs of the first three cities will be erected. The steam plant at Managua will then be moved to Leon.

It has been decided that by constructing a dam about 5 ft. high at the edge of Tipitapa Falls, Lake Managua (of which the Tipitapa River is the outlet) can be maintained at a sufficiently high level to always give an ample supply of water for the power required. Mr. Warren B. Reed, the concessionnaires' electrical engineer, calculates that by raising the lake 1 ft. more than its annual evaporation, about 20,000,000,000 cu. ft. of water will be secured; and that by placing the power house about 500 yards below the falls, at the foot of the rapids, a fall of 18 ft. will be obtained, which will give sufficient power to run the plant for four consecutive years, even if there should be no rain during that time.

The Government has also granted Messrs. Solomon & Ramirez exemption from import duties on all materials to be used in the enterprise and on provisions and clothing for their employes.

The contract provides the following rates for each light installed:

Description.	Rate.	
	Pesos.	
One 16 cp	6.50	*$1.85
One button and switch	3.00	.85
100 ft. of wire	18.50	5.28
Monthly charge	3.00	.85

*Value in United States gold at present rate of exchange.

Bids are being received for the poles, and machinery has already been ordered from the United States. The plant is to be in working order within six months from date.

New Telephone Patents.

Telephone patents for the issue of Jan. 28 number two only, and neither is likely to revolutionize the art of telephony. Mr. Charles F. Butte, of San Francisco, Calif., patents a self-ejecting plug for telephone switchboards, which is an extremely simple device, as the diagram (Fig. 1) shows, but which for various reasons stands little chance of adoption in practice. Each jack has mounted above it an electromagnet having for its armature a bell crank lever, the free end of which is adapted to engage in a shoulder of the plug. When the magnet is energized by the disconnection signal relay, it attracts the armature, ejecting the plug from the jack by the action of the lever against the shoulder. As the magnet is included in the cord circuit the ejection of the plug breaks the circuit between the battery and the magnet, de-energizing the latter.

One trouble with this device would be that in order to ensure firm contacts a plug has to fit pretty snugly into the jack and to eject a properly made plug from a properly made jack by means of a right-angled lever would require a very powerful electromagnet. Further, the space required for the magnets would debar such a device from

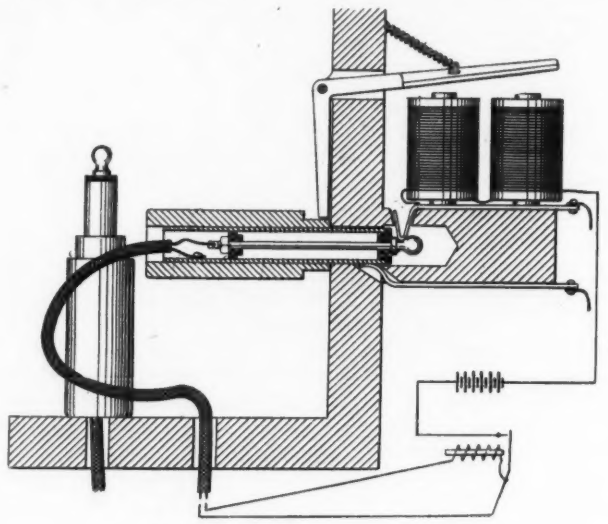


FIG. 1.—BUTTE'S TELEPHONE SWITCHBOARD.

large switchboards, and in small ones it would be of little advantage, since the operator generally has plenty of spare time.

Mr. Albert K. Andrians, of San Francisco, Calif., patents and assigns to the Automatic Interconnecting Telephone Company, of the same place, a switching mechanism for interconnecting telephone lines adapted for use on telephone systems composed of a comparatively small number of lines combined for operation on the interconnecting plan. The invention provides a switch mechanism of enlarged capacity, capable of affording connection with a considerable number of lines and of such compact form that the line contacts and entire switch mechanism can be contained in the base of a portable telephone stand for the desk or table. The switching mechanism is locked when the receiver is on the hook, and can be moved off the

"home" contact only when the receiver is lifted from the hook, and is automatically returned to the "home" contact when the receiver is hung up after connection with another line has been had.

Figs. 2, 3 and 4 show pretty clearly the construction and mechanism of this ingenious device. A number of stationary contacts are ar-

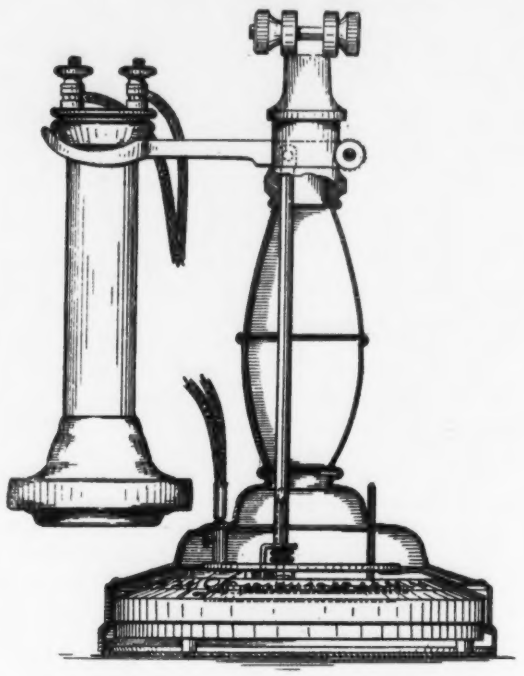
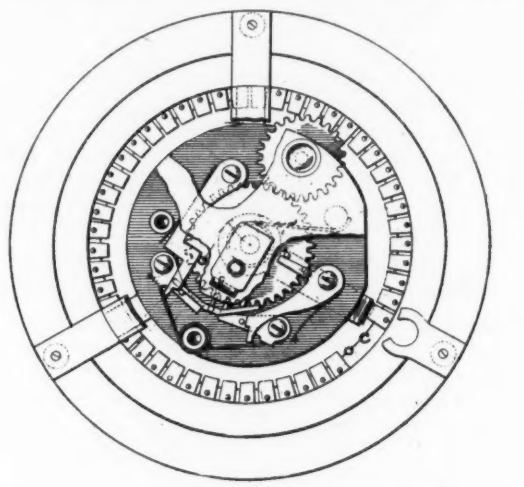
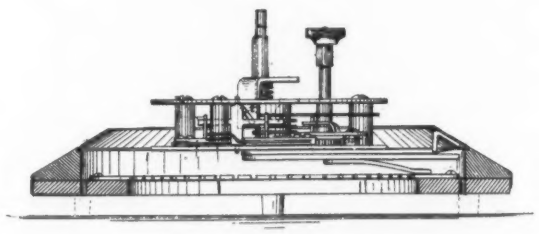


FIG. 2.—ANDRIANO'S SWITCHING MECHANISM.

ranged in a circle on the base block, and a contact arm is carried on a separate frame with the setting and locking mechanism. An annular dial plate turned by means of shaft connects by gear and pinion with the shaft carrying the contact arm. When the arm is turned to the required contact it is locked by a dog, which holds it on the selected contact until the receiver is replaced on the hook, when a rod releases the dog and the coiled spring returns to zero





FIGS. 3 AND 4.—ANDRIANO'S SWITCHING MECHANISM.

or "home" contact. The dog then locks the gear until the rod releases it by the raising of the switch-hook. It is thus necessary to raise the receiver from the hook before the switch can be operated, and when the receiver is replaced the switch is automatically restored to zero.

CURRENT NEWS AND NOTES.

PACIFIC CABLE.—A brisk pamphlet, which includes some of the documents in the case, has been issued to the public by the Commercial Pacific Cable Company, in support of its work for laying an unsubsidized Pacific cable and against the plan for a United States Government cable.

NEW LONDON (CONN.) MUNICIPALIZING.—The New London Board of Trade has appointed a committee of five to consider the purchase by the city of the New London Street Railway property, and the local electric and gas plants. The sentiment of the board was strongly in favor of the purchase. The railway company holds practically a franchise for the whole city.

GERMAN WOMEN EMPLOYES.—Beginning with the new year, Germany has taken a long step forward in employing woman labor in all Government departments, and especially so in two. Between Jan. 1, 1902, and Dec. 31, 1905—that is, in four years—5000 women and girls are to be employed in the State railway offices and in the post, telegraph and telephone services, the number of girls employed to be raised from 7000 to 25,000.

UNITED STATES PATENT OFFICE.—Commissioner of Patents Allen reports that the number of patents issued last year was 27,373, the largest in the history of the department. The issue of certificates of registration of trade marks, prints and labels also reached the unprecedented number of 2965. Cash receipts of the office during 1901 were $1,249,198, exceeding those of any previous year by nearly $100,000. The State whose citizens received the largest number of patents during the year was New York, with 4098, next in order came Pennsylvania with 2837, Illinois with 2430 and Massachusetts with 1905.

INVENTION OF WIRELESS TELEGRAPHY.—According to a press cablegram, Marconi's claims to the invention of wireless telegraphy were severely criticised at a meeting last week of the French Academy of Sciences. According to documentary evidence adduced credit for the invention is due, first, to Feddersen and Maxwell, both Englishmen; then to Hertz, of Germany; but principally to Professor Branly, a Frenchman, who conceived and constructed in 1890 the receiver for electric waves which is used by Marconi; and next to Professor Lodge, an Englishman, who read a paper before the Electrical Congress of 1894 pointing out the possibility of transmitting telegraphic signals with the Hertz apparatus and receiving them with the Branly tube of metallic fillings, which possibility was actually put into practice by the Russian scientist, Popoff, in 1896. It was further asserted that most of Marconi's patents are worthless, owing to the foregoing facts. Finally, it was pointed out that neither the French nor the German Army nor the English Navy is using the Marconi system, though results are obtained equal to those obtained with his apparatus, except transmission across the ocean, which the scientists unanimously decided is yet unproved.

TEXAS FUEL OIL TESTS.—A Texas oil company has printed a report of Professor J. E. Denton, of Stevens Institute, upon tests at Beaumont, Texas, of crude petroleum as fuel, made for the company. The tests were made in a horizontal return tubular boiler 6 ft. in diameter, 18 ft. long, and having a grate surface of 45.5 sq. ft. In the tests, data for comparative purposes were obtained from the same boiler when burning buckwheat anthracite coal. With Beaumont crude oil the equivalent evaporation from and at 212 degs. was 15.49 lbs. of water per pound of oil. The corresponding figure when using buckwheat coal was 11.79 lbs. of water per pound of combustible, and 8.94 per pound of coal. The efficiency of the boiler determined by the oil tests was 78.5 per cent, and by the coal tests 77.6 per cent. A quantity of steam varying from 3.1 to 4.8 per cent was consumed in the oil blast. In the two tests with coal the horsepower developed by the boiler was 92.6 and 119.1. In the five tests with oil the horse-power varied from 112.7 to 220.1 hp, the evaporation per pound of oil from and at 212 degs. in the first-mentioned case being 15.05 and in the second 14.75. These figures are considerable less than those that have been obtained with Eastern crude petroleum, which range above 18 lbs. of water per pound of oil.

ELECTRIC LIGHT ON TRAINS.—Mr. G. W. Roosevelt, United States Consul at Brussels, reports that owing to the very satisfactory results obtained with the Stone system of electric lighting on 205 cars, it has been decided by the Belgian State Railways to equip another 141 cars in the same manner.

A. I. E. E.—The new membership list of the American Institute of Electrical Engineers has just been issued. It now includes 1412 names, comprising 2 honorary members, 393 full members, and 1017 associate. Seventy-five per cent of the membership is outside New York City. There are 52 members in England, 38 in the Dominion, 12 in Australia, 11 in Japan, 13 in France and 14 in Germany.

SYNCHRONIZING ALTERNATORS.—In a patent issued Jan. 28 to J. E. Woodbridge, a method of synchronizing alternators is described, which is claimed to be superior to the methods of synchronization in which corresponding phases are connected in conjunction or in opposition. It is stated that when machines are synchronized by means of corresponding phases in opposition and thereby producing a maximum e. m. f. at synchronism, considerable variations of phase angle may occur without appreciably altering the resultant; while in synchronizing by connecting in opposition the occurrence of minimum or zero e. m. f. is difficult to determine. To overcome these objections, instead of combining corresponding phases of the machines to be synchronized, the e. m. f.'s employed are obtained by connection with phases which are not in phase when the machines are in synchronism. In the case of two-phase generators, for example, the *A* phase of one machine is employed in combination with the *B* phase of another machine. By this method, at the instant of synchronism the resultant e. m. f. due to the combination has a comparatively large value, which may be easily read by indicating instruments, and in addition is sensitive to even slight changes in phase relation of the machines.

REGULATION OF ROTARY CONVERTER E. M. F.—A means of regulating the e. m. f. of rotary converters by the employment of an induction motor is the subject of a patent issued Jan. 28 to B. G. Lamme. The rotor of an induction motor is mounted on the same shaft with the armature of the converter, and has a larger number of poles than that of the converter. As indicated in the drawing, the motor has six poles and the rotary converter four poles. Assuming a three-phase circuit, the stator of the motor has three independent windings, which windings are in series with the collector brushes of the converter; that is to say, the windings form part of the alternating-current supply circuit of the converter. Since the converter is operated from an approximately constant potential circuit, its speed and that of the motor, and consequently the slip of the latter will be approximately constant for all loads. When an induction motor is rotated either above or below synchronous speed, any variation in current input or output must be caused by a variation in voltage, the slip being constant as in the present case. It follows, therefore, that as the load on the direct-current side of the converter varies, the alternating current to supply the load varies, and such current variation is in turn dependent upon voltage variations of the motor, which reinforce the e. m. f. component of the converter in accordance with the changes in load on the converter. If the currents to the converter are of such volume that an inconvenient winding would be required on the motor, the latter may be supplied from the secondaries of transformers, the primaries of which are in the alternating-current supply leads to the converter.

LETTERS TO THE EDITORS.

Distribution and Meter Losses.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with very great interest the editorial on page 113 of ELECTRICAL WORLD AND ENGINEER of Dec. 21, 1901, dealing with the question of line losses, and more particularly meter losses. Having devoted the greater portion of the past 15 years to the study of electric meters and things kindred to them, I feel somewhat justified in venturing to comment on, and in some measure to differ with, the statements made in these editorial paragraphs.

I am familiar with the fact that there is a strong tendency among some central station managements to attribute a very heavy percentage of loss to the meter system. I am ready also to admit without argument that a very considerable percentage of loss is justifiably attributable to this part of equipment.

The figures cited in your editorial, showing from 17 per cent loss for an efficiently managed direct-current meter system, to 25 per cent for an alternating-current meter system are, in my opinion, very excessive and hardly to be found at all in modern practice.

It would be very rash for me to challenge such figures on the score of my opinion and judgment alone, and I do not do so. It has been my privilege to see a very large number of tests, representing the performance of thousands of meters in commercial service, of all ages and at widely scattered points, and at all loads. When one has inspected a sufficient number of such tests, and has compared their showing with the average relation of meter capacity to the load curve of the station under consideration, one can readily form a very close approximation of the actual losses; a much closer approximation in my opinion than can be made in any other way now available to us.

We must remember that the present so-called method of determining the meter losses of an entire system is a process of elimination. The first point of weakness in the method of determining this data lies in the accuracy with which the gross output of the station is measured. The devices by which such determinations are made are commonly as fallible as the customers' recording meters, but in the opposite direction. When central station total output meters or central station managers err they commonly read high, whilst the reverse is true of the meter on the customer's premises. If the output is determined by recording meters they are commonly of the same general type as those which are being used on the customer's premises, and they are equally fallible. They are, however, being used under more adverse conditions, they are under heavier vibration, and are more likely to be exposed to stray fields of a deranging kind, etc. If, on the other hand, the output is determined by periodic readings of ammeters and voltmeters, we have the errors of the instruments, errors which unfortunately are by no means unusual and which are generally high; and we have also the errors of integration and of observation.

I submit, therefore, that the first opportunity for error in this matter lies in the determination of total output. Having determined the total output billed current, line losses and all other losses are subtracted one after the other, as known and fixed quantities, and this process of elimination having been carried to its conclusion, the remainder is regarded as the loss chargeable to the unfortunate meter system. This practice has been borrowed from the school of the gas engineer, who for years has been accustomed to determine his pipe leakages in just this way, by elimination; and in the case of the gas engineer, the meter loss is subtracted as a more or less known value; generally, I believe, at about 5 per cent.

What I desire to point out, therefore, is that the 17 per cent or the 25 per cent cited in the editorial, or any other value which may be obtained by the process of elimination as the true value of meter losses, in reality does not represent meter losses, but meter losses plus the sum of the errors of determination of all of the other factors considered. I have actually seen meter losses determined by the system of elimination when one of the known factors deducted from the total output was a "very accurate estimate of energy supplied to contract customers without meters."

As to the greater or less efficiency of an alternating or direct-current meter system, there is, in my opinion, little or nothing to choose between the two, *per se*. I do not doubt that the gravest difference can be found in favor of direct or in favor of alternating plants, which are close neighbors and under equally management. Very large alternating-current systems are frequently handicapped by a large number of very old and, therefore, relatively primitive recording meters. Alternating-current meters have been on the market a very long time, and were rapidly purchased on their first introduction. Such meters necessarily have a short range of accuracy and under-record heavily on light loads. This situation handicaps the average alternating-current meter system.

On the other hand, inductive loads are very common, and during certain portions of the load curve constitute a large proportion of the load of most alternating-current stations.

Meters of the induction type which are accurate on inductive loads, have only been available for a relatively brief time. Prior

to the time when they became available such meters had errors either fast or slow on inductive loads, generally fast; in some cases very fast. Consequently, inductive loads have doubtless in many cases served to offset natural slow operation to a very appreciable degree, amounting to a good deal, in the betterment of general meter efficiency, though hardly in a way which one would advocate. The actual meter loss of a well managed system to-day may be as low as 6 or 7 per cent, and should not and rarely does not exceed 10 per cent. Much but not all of this is controllable.

I indorse heartily that portion of your editorial notes which deals with the question of meter maintenance. For the average central station periodic visits on the premises are probably the most economical and efficacious means of up-keep. Conditions, however, do exist in some large cities where the test on the premises is probably less desirable than the test by removal, but such cases are, I believe, rare, and I should be reluctant to advise any practice except the test on the premises without a special and very careful investigation.

The term "test on the premises" is here used more in the sense of inspection than literally a test. A test of a meter with ammeter and voltmeter, or the equivalent, is comparatively unimportant as compared with a careful mechanical inspection and an accurate adjustment of the friction compensation with which most modern meters are provided. The elimination of loose dust or dirt, the up-keep of jewels and bearings, and the adjustment of light load accuracy by the means provided, are the secrets of meter efficiency. The magnets rarely require to be touchd at all and should only be touched under considerable provocation. In the case of commutator meters the cleaning of the commutator so long advised is no longer regarded as desirable save in the exceptional cases where actual building up of rough particles due to sparking has taken place. It is now a well established fact that the average meter commutator reaches practically a permanent condition of friction after three to six months of use. That is, the light load accuracy has in this period depreciated all that it will depreciate on the score of the commutator. It is expedient, therefore, not to destroy this permanent condition of the commutator, but to leave it as it is and adjust the friction compensation until the meter is restored to a condition of accuracy on light loads, which it should then retain.

SCHENECTADY, N. Y. CARYL D. HASKINS.

Death by Electricity

To the Editors of Electrical World and Engineer:

Sirs.—I read with much interest your editorial comments on my communication in your issue of Jan. 25. I have, however, failed to note in any reports of autopsies that I have read any important organic changes in vital organs, not even the great nerve centers. The only important change noted has seemed to be a fluid state of the blood, and a preponderance of white corpuscles in the blood. Now, as in my opinion, death, when it does result from an electric shock, occurs from paralysis of the heart and nerve centers of respiration. This very fact of the fluidity of the blood is in itself an argument that resuscitation is possible, as the mere fact of the heart's action ceasing does not determine the fact of death unless the blood coagulates. I believe a very interesting experiment was recently made by a European doctor of inducing life in a man supposedly dead by manipulating the heart itself by the hands.

Another fact that renders it an easier task to resuscitate the victim of an electric shock than one of drowning is the fact that in the former case the lungs are free of water, and, therefore, more readily respond to artificial respiration. Of course, while I do not hold that death does not result from an electric shock, yet I affirm that in the majority of cases where the amperage has not been heavy enough to produce lesions of vital organs, the methods I have mentioned should never be given up while the body is still pliable, and I have no hesitancy in stating my belief that many valuable lives have been lost through a lack of knowledge of this subject. I speak of the amperage as it is the *quantity* that passes that would produce lesions at a high pressure, as enormous pressures have been taken through the body in infinitesimal quantities without harm. Of course, in the case of a prolonged application of current, as in the case of an electrical execution, the Joulean effect or raising of temperature might cause internal burns sufficiently severe to cause death beyond all chance of recovery, as very slight external burns over a large surface do, but I have never, to my recollection, read of this point being demonstrated at the autopsies. But in any case when the contact has been momentary, as the majority of the accidentally received are, the efforts to revive should be unceasing while a spark of hope remains, i. e., until *rigor mortis* actually sets in.

LORAIN, OHIO. C. H. HINES.

[In the case of unconsciousness from electric shock, it would be well-nigh criminal to neglect measures of resuscitation, for undoubtedly in most cases the patient can be revived if the treatment for the drowned be applied. Some years ago this journal distributed to central stations and other electrical generating plants many thousand copies of a sheet of instructions for the resuscitation of those rendered unconscious by an electric shock, and soon after several cases were reported to us where the application of these instructions resulted in the saving of life. As to electrocution, in 1895 Governor Flower, at the request of this journal, appointed Dr. A. E. Kennelly and the eminent therapeutist, Dr. A. H. Goelet, to witness and report on the electrical execution of a criminal at Sing Sing. The report, which was printed in our issue of Feb. 16, 1895, is decisive as to physiological death. There was extravasion of blood in all parts of the body, tissues of the brain and blood vessels were ruptured, and it was estimated that at least two quarts of blood escaped from the scalp and cranium in removing the brain.—EDS.]

Induction Coils.

To the Editors of Electrical World and Engineer:

Sirs.—The editorial in your issue of Jan. 25, entitled "The Function of the Condenser in the Induction Coil," suggests that a large experimental field presents itself for the complete investigation of induction coil phenomena.

There are perhaps few who better realize to what an extent such an investigation could be carried than those persons who are daily experimenting with induction coils of various types and sizes. While from a theoretical standpoint such an investigation would no doubt prove of great value, in that definite rules might be laid down to secure any desired result, nevertheless, from a manufacturer's standpoint, the various relations existing between primary, secondary and condenser have been looked into so extensively that the output of a coil can be estimated beforehand with considerable accuracy.

Several years ago a manufacturing company undertook the construction of two induction coils, each to give a 1-meter spark, which construction was preceded by an extended series of tests to determine fully the functions of and the relations existing between the primary, secondary and condenser.

These experiments were conducted in a most careful manner, and from the results obtained many surprising and interesting conclusions were drawn. Curves of primary currents were plotted, showing oscillations in the circuit when it was opened, lasting from .01 second to .05 second; curves illustrating the rise and fall of the potential at the condenser terminals, and its effect upon the primary current; curves showing the changes in primary and secondary oscillations as condenser capacity was varied. In fact, the investigation was as complete as was considered necessary to develop all the detail requisite in coil construction. However, there were many interesting points, not deemed to be essential in commercial work, which were merely touched upon, and which would require extended investigation to make complete.

At that time, the writer proposed to a professor in one of our leading scientific institutions that a careful study of these phenomena would form an excellent subject for a graduation thesis.

It is quite possible that at no distant date the results obtained at that time will be published, and I feel sure that they would prove of value to those interested in this line of work.

PHILADELPHIA, PA. WM. B. HODGE.

A Winter Use for Fans.

To the Editors of Electrical World and Engineer:

Sirs.—The thermometer to-day is registering six below zero here in Chicago. Passing along Van Buren Street I noticed the windows of the shops were so thickly encrusted with frost that it was impossible to tell what business the proprietor of any shop was engaged in without consulting the signs. Suddenly at Wabash Avenue a large, attractive-looking window of a sporting goods house burst into full view with everything in the window as plainly visible as it would be on a bright mid-summer's day, only more prominently emphasized on account of the indistinct condition of every other window one

could see on the block. My attention was arrested by the phenomena, and pausing I noticed in the window a 14-inch electric fan running full blast. I stepped in and asked the proprietor if the fan was being employed to keep his window free of frost, and he stated that that was its object, and it did its work splendidly; that they had tried it last winter and found it worked so successfully that they had not taken down their fans, but always on a very cold day, when they found their windows encrusted with frost and ice in the morning they turned on the breeze, which rapidly cleared the windows and kept them dry and clean all day.

It struck me as a novel use for an electric fan, and one which would commend itself to many shopkeepers as an aid to displaying their goods during the cold weather.

CHICAGO, ILL. HERBERT CLARK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Calculation of the Voltage Drop of Alternating-Current Generators.—FISCHER-HINNEN.—A long article with various diagrams and tables. For the calculation of the voltage drop of an alternator two methods have been in use—that of Behn-Eschenburg, who determines the voltage at the terminals from the no-load voltage and the e. m. f. of self-induction; and that of Rothert, who combines the m. m. f.'s. In general, the former method gives the voltage at the terminals smaller than found by experiment, and it is smaller the more saturated the machine is and the greater the phase difference. On the other hand, the voltage at the terminals, as calculated by the method of Rothert, is generally greater than that found by experiment. Recently Potier has developed a third method which may be regarded as a combination of the above two methods. He makes two calculations. From the ampere-turns of the magnets and the ampere-turns of the armature he first determines the resulting m. m. f. The e. m. f., taken from the no-load curve for the resulting excitation, is then combined with the e. m. f. of armature straying. He has examined the three methods for 15 different machines, the results being given in two tables, which show that Potier's method gives quite satisfactory and much better results than the two former methods. The calculation by Potier's method is, however, somewhat long and inconvenient for the practice. The present author has, therefore, calculated two tables, which facilitate the application of Potier's method in practice. Some numerical examples are given.—*Elek. Zeit.*, Dec. 26.

Induction Motor with Adjustable Speed.—An illustrated article on an induction motor, made by Wuest & Co., which gives a certain power at greatly varying speed with an approximately good efficiency. The motor consists of three parallel and co-axial three-phase stators, placed in a case, having a four-pole, six-pole and eight-pole winding, respectively, while the rotors of the squirrel cage type are mounted on a common axle. With three-phase currents of 50 periods, and if the three different windings are used separately, speeds of 1500 to 1400, 1000 to 900, 750 to 700 can be obtained. Each of the three separate motors is said to give a certain power at nearly equal efficiency. When two or three of the separate motors are connected in parallel, it is claimed that the power is doubled or tripled, respectively, under fair economical conditions, the speed being 800 to 700 in both cases. The results of some preliminary tests are given.—*Zeit. f. Elek.*, Dec. 29.

Rectifying Alternating-Currents.—An illustrated description of the Batten rectifier, which has been designed primarily to charge accumulators from alternating-current sources. The disadvantage of a synchronous vibrating armature, like a vibrating reed or tongue, for commutating alternating current, has the disadvantage that the vibrations of the reed lag in phase behind the alternations of e. m. f., with the result that the reed does not commence its movement in any period until the e. m. f. has risen to a considerable portion of its ultimate value, and a spark takes place at the point where the circuit is broken. In the Batten rectifier this disadvantage is said to be avoided. "The current driving the armature is taken direct from the mains, through a lamp which reduces the current to an amount not more than sufficient for the purpose. The primary of a small transformer is also connected to the above-mentioned mains, the secondary of the transformer providing the current to be rectified. It thus happens that the lag in phase of the secondary current behind the primary current compensates for the lag in movement, due to the mechanical inertia of the armature, and the small self-induction of the driving electro-magnet. In practice the lag in the transformer is not quite sufficient for the purpose, but to 'tune up' a condenser is put across the terminals of the lamp in the driving circuit, and the result is that no spark whatever occurs, even with a load of 6 amperes, as the contact is made and broken at equal periods on either side of the zero potential line, so that the e. m. f. had insufficient time to rise to any appreciable value."—Lond. *Elec. Rev.*, Jan. 3.

REFERENCES.

Capacity Limits of Direct-Current Dynamos and Motors.—ADAMS.—A general discussion of the various safe capacity limits of direct dynamos and motors, as fixed by speeds of armature rotation, by the allowable rise in temperature of the windings, commutator and brushes, by the effect of armature reaction to lower the voltage, by the permissible sparking at the commutator and by the ability of their insulation to withstand voltage.—*The Eng.*, Jan. 1.

Electric Motors.—WHITE.—A continuation of his article on the testing and management of electric motors. This part deals mainly with the management. He discusses the motor connections and gives some practical rules.—Lond. *Elec. Rev.*, Jan. 3.

POWER.

Water Power Developments in Europe.—MAHN.—A statistical summary of recent developments. In Italy there are no less than 2,640,000 hp available for industrial use; 300,000 hp of this total has already been developed. The power now running to waste in the rivers of France is estimated by Tavernier at 3,000,000 to 5,000,000 hp, and only 200,000 hp of this enormous total has yet been utilized. As regards the costs of the hp-year measured at the turbine wheel, the average cost in Switzerland is $20, in Savoy $9, and in Italy over $20. In Norway and Sweden the three largest falls represent over 244,000 hp; only 22,000 hp of this total has been developed. Near Christiana, the Glommen River might be utilized for a development of 92,000 hp, and the River Drammen for an additional 28,000 hp. Works were commenced there last year, but the power station is not yet completed. In Germany a new water-power station has recently been completed at Gersthofen, near Augsburg, where 7500 hp is available. An interesting feature of this station is that 3000-kw, direct-current, is generated, and is transmitted by underground aluminum cables to color works at Hoechst.—*Zeit. f. Elektrochemie*, Dec. 5; abstracted in Lond. *Elec.*, Jan. 17.

Some editorial notes of the prospects of commercial development of the above water power. In some cases the permanent expenditure in civil engineering costs would be so heavy that remunerative return would be impossible. In more favorable situations the return would be a fair manufacturing percentage, and "in selected instances with cheap and constant power, accessibility of site and nearness of raw materials, there is the mechanical equivalent of a gold mine to be annexed by the enterprising. The utilization of the power is more difficult than the winning of it. These vast quantities of energy are more than can be absorbed in any profitable way except by the aid of electro-chemistry." * * * "Even now, with the shortest time for experiment ever accorded the pioneer of a new technos, the electro-chemist is competent to handle this power to commercial advantage."—Lond. *Elec.*, Jan. 17.

Torsional Oscillations in High-Speed Engine Shafts.—LEAKE.—A communication referring to a recent paper of Frith and Lamb. He points out that dangerous oscillations may be set up without exact synchronism, between the turning moment and the natural oscilla-

tions, so that for every set there is a range of speeds such that dangerous oscillations are set up at any speed. He gives particulars of some sets which have given trouble due to such oscillations. The capacities were 350, 400, 450, 500 kw, respectively; the normal speed 318, 295, 300, 330 revolutions; the critical speed calculated by him 331, 293, 278, 321 revolutions. "These four sets are of usual design, and include the work of five well-known manufacturers. By critical speed is meant the speed at which the amplitude of torsional oscillations should theoretically be a maximum, and it will be noticed that these do not differ much from the normal speeds. In the case of three of the above sets signs of trouble appeared, and finally the shafts cracked." These mechanical oscillations afford a close analogy to the oscillations which occur in the parallel operation of synchronous alternating-current machinery.—Lond. *Elec.*, Jan. 3.

LAMB and FRITH.—A reply by the authors of the original paper. They agree in most points with Leake.—Lond. *Elec.*, Jan. 10.

Another reply by Leake in Lond. *Elec.*, Jan. 17.

The Dynamo as an Adjunct to the Blast Furnace.—ALLEN.—An article in which he says that in all blast furnace installations there should be an electric plant, the output of which would be controlled by the possibilities of application. One use would be to supply current for arc lamps for the general lighting of the founding shed and the exposed places and incandescent lamps for the office. The dynamo would probably be designed to give 220 volts, and if capable to give from 160 to 1000 amperes, it can be used for effecting many cases of repair and remedying accidental irregularities of the furnace. For fusion or welding by the electric arc the usual voltage is 50 to 80, so that rotary transformers or resistances are to be applied. It is essential that the voltage should be regulated between 50 and 80 to suit the requirements. Grammer has used the electric arc to burn open the tuyeres and iron-notch of a blast furnace on occasions when, owing to some accidental occurrence, the iron has become chilled, in place of their having to be opened by the long and laborious method of hammer and drill or the application of the kerosene blowpipe. Foster has given an instance of the repairing of an eccentric rod of a large reversing engine by electric welding, the engine being at work the morning after the breakdown; also of the slot link of a reversing engine, in which case the engine was working again within an hour; cutting holes in iron or steel castings, plates, etc., in situ can readily be performed.—Lond. *Elec. Rev.*, Jan. 3.

REFERENCE.

Electric Winch.—A description of a winch used in an English colliery plant. It consists of a motor directly connected to a winch by an automatic attachment. An electric brake is put on the drum as soon as the current is switched off of the motor, and this brake is released when the current is put on the motor.—*St. R'y Jour.*, Int. Ed., Jan.

TRACTION.

Elevated Railway Repair Shop Methods in Chicago.—An illustrated article. The motor cars on this road are each equipped with four G. E. 55 motors, in which the field frame is not divided in halves as usual, but has an opening in the end of the case through which the armature is taken out. The armature is removed from the field frame by a special machine. The process is rather a slow one. however, and it is believed that that employed on the Lake Street road, described below, is superior. In the Metropolitan shops the room under the crane is not sufficient to allow of the method used in the Lake Street road. In this latter the motor is set on end with pinion up, and the armature is hoisted directly out of the case. Some excellent records have been made with the G. E. 55 motors used on the road. Both pinions and the pinion bearings have run for more than 133,000 miles, with very little wear. On the Northwestern Elevated Road a special mixture of armature bearing metal is used consisting of 100 parts of lead to 7 of antimony. This mixture is also used on the truck journal box bearings for both the Lake Street and Northwestern Elevated roads. Oil is used on these bearings. The method of feeding the oil to the bearings is described.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Large Power Station for Manchester.—A brief article on this station, which will contain six cross compound engines of 3000 hp capacity, each direct coupled to three-phase generators of 6 to 500 volts. The condensers, fans, coal carriers, etc., will be operated by direct-current motors supplied by three 230-kw engines and generators. The three-phase generators will be excited by this auxiliary plant at starting and afterwards by direct-current generators driven by induction motors. The sub-station will contain 30 motor-generators of 350-kw each, 18 of which will be used for traction and 12 for lighting purposes. The electric equipment will be supplied by the General Electric Company, of Berlin.—*St. R'y Jour.*, Int. Ed., Jan.

Electric Traction.—BELL.—An article on "Present tendencies in electric traction." The two branches of urban traction, surface and other, are both growing along sound and fairly steady lines. The suburban and interurban lines are rapidly opening an operative gap between themselves and the urban systems. The interurban roads "must choose implicitly, if not openly and under compulsion, whether they will conform to tramway limitations as to speed and equipment and enjoy the immunities of tramways, or take openly the position and duties of passenger railways operated by electric motors." The hundred-mile-an-hour train is a matter which stands by itself, and cannot be regarded as an extension of present tramway practice. He speaks well of the German experiments on the Zossen railroad, and "is strongly of the opinion that for high-speed work on a large scale the use of polyphase distribution directly to the motors, presents so great advantages as to make any other method yet suggested of more than dubious utility."—*Elec. Rev.*, Jan. 11.

Device for Cutting Sleet on Third Rail in Electric Railways.—An illustrated description of a device used in Chicago. The blades of the brush are 3-16 inch thick, and they are held in a block of iron, which is cast around them. They are pressed down on the rail when desired by a long plate spring.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

REFERENCES.

Interurban Railway.—KIBBE.—A long illustrated description of the Chicago & Joliet interurban electric railway.—*St. R'y Rev.*, Jan. 15.

Brighton.—A short illustrated description of the municipal tramways of Brighton, England.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Worcester.—An illustrated article on the re-arrangement of the power generating and distributing scheme for traction at Worcester, Mass.—*St. R'y Rev.*, Jan. 15.

Street Car Platforms.—PARTRIDGE.—A continuation of his article He illustrates and comments on 19 different types of platforms, pointing out the advantages and disadvantages of each.—*St. R'y Jour.*, Jan. 4, and Int. Ed., Jan.

Automobiles.—An illustrated description of the electric automobiles, exhibited at the fourth international automobile exhibition, held in Paris last December.—*L'Ind. Elec.*, Dec. 25.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Modern Tendencies in Electrical Distribution.—An editorial in which the old alternating versus direct-current controversy is said to take at present this form: Given that the electrical energy is generated as two or three-phase high-pressure current in a plant at a distance from the main area of supply, should the current be distributed as alternating current after a simple transformation in stationary transformers, or should it be converted to direct current by rotary converters? In Great Britain, out of a total of 56 new stations started during 1901, only two small ones were on the single-phase system, while several that are already running are now supplying two-phase and direct current in addition to single-phase alternating. "If large works, such as those of the Metropolitan Elec. Supply Co., the City of London Electric Lighting Co., and the municipal electricity works at Leeds, Sheffield, Bristol, Huddersfield and Worcester were built to-day, they would probably not put in one single-phase machine, although at present the supply is wholly on this system in some of these works, and to a large extent in the remainder. The conditions in the United States differ to some extent, however, from those obtaining in this country. There the practice of 'scrapping' plant wholesale, in order to substitute modern machinery and methods accords more with the inherent character of the people, and is accentuated by the high cost of labor, both skilled and unskilled. On the other hand, the extremely slow introduction of a consumers' pressure of 220 volts amounts almost to a conservatism, which is the last thing one would expect to meet with in the States. Perhaps it is to a certain extent due to the habit of attributing less importance to saving material than to saving labor." A review is given of the papers of Ferguson, Scott and Emmet, read some time ago before the Am. Inst. Elec. Eng.—Lond. *Elec.*, Jan. 10.

British Central Station Statistics.—A statistical article with two tables and 12 diagrams on electricity supply works costs in 1899 and

1900 in municipal and company plants in Great Britain. The important feature of the year 1900 was the abnormally high price of coal. The following are average values of some of the principal municipal plants: Units sold per 8-cp lamps capacity, 20.8 in 1900, against 19.8 in 1899; fuel costs in cents per unit sold, 1.94, against 1.48; total revenue in cents per unit sold, 7.44, against 7.88; total costs in cents per unit sold 4.48, against 4.30; ratio of total revenue in per cent 62, against 56. The corresponding average values for company plants are: Units sold per 8-cp lamp capacity 21.3 in 1900, against 19.4 in 1899; fuel costs in cents per unit sold 2.20, against 1.94; total revenue in cents per unit sold 10.18, against 11.20; total costs in cents per unit sold 5.36, against 5.64; ratio of total costs to total revenue in per cents 54, against 51. Several features of the statistics of the last five years are well brought out in diagrams. In the case of municipal plants the total revenue in 1900 was equal to the total costs plus 5 per cent of the mean capital expended, while for the companies their average total revenue was equivalent to their average total costs plus 5.6 per cent of their mean expended capital. The curves relating costs per unit with output, and per unit with load factor, show that if "the payments out of revenue in respect of capital charges were according to the above scale," i. e., 5 and 5.6 per cent, respectively, of the mean expended capital, there would in general be a deficit for the small and a surplus for the large undertakings.—Lond. *Elec.*, Jan. 3.

The very large annual table of all the central stations in the United Kingdom, which are in operation or are being erected, with a large amount of statistical information; also a summary with diagrams. The total connections in London now amount to 129,400 kw, against 105,400 kw last year. The connections to provincial stations have increased at a far greater rate than the London ones, largely to be accounted for by the increased tramway load on the combined lighting and traction stations. The grand total for London and provinces approaches 400,000 kw, or about 13,000,000 8-cp lamps, an increase of 3,000,000 over last year.—Lond. *Elec.*, Jan. 10.

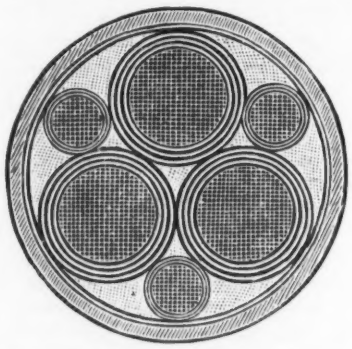
La Bourboule.—An illustrated description of the new power plant of the City of La Bourboule in France, by the Fives-Lille Company. There is a 100-kw direct-current dynamo, and two 3200-volt, three-phase generators, one of 100 kw and one of 150 kw. The switchboard and the phase indicator for connecting the alternators in parallel are described. The Dobrowolsky system is used for supplying a three-wire system from a single dynamo. It has been described before in the Digest.—*L'Ind. Elec.*, Dec. 25.

REFERENCE.

New York.—A well illustrated description of the new waterside station of the New York Edison Co.—*Power*, Jan.

Three-Phase Distribution for Power and Lighting.—WOODFIELD.—An illustrated article in which he discusses the advantage of the three-phase system for power and light supply, and describes several methods of applying the three-phase system.—Lond. *Elec. Rev.*, Jan. 3.

Distribution Cable for Three-Phase Working.—An article in which the well-known fact is first proved that the use of a fourth neutral wire in three-phase working allows a great saving of copper. The



CABLE FOR THREE-PHASE DISTRIBUTION.

problem is how to best place the neutral wire relatively to the three principal conductors in a cable. It has been proposed to strand this conductor over the three main cores after they have been laid up, but this considerably increases the outside diameter of the cable, at the same time making the joint very difficult, while another proposal has been to strand the fourth conductor up with the other three, which arrangement is unsymmetrical and will throw out the balance of the system, besides making the outside of the cable larger than it need be. In Esson's cable, which is shown in the adjoining diagram, the neutral conductor is divided into three parts, and with regard to the principal conductors these are placed each in the external recess formed between the contiguous principal conductor, so that, like the principal conductors, they are disposed in triangular form. In manufacturing the cable, the separate constituent conductors are laid or twisted along with the three principal conductors, and may or may not be separately insulated. If separately insulated, the covering may be less heavy than that of the principal conductors. The cable thus formed is lapped outside and lead-covered in the usual way, the space between the conductors and the lead being packed with jute or other filling. The three constituent conductors of the neutral wire are united at each joint box in a very simple way, and one of the consumers' connections is made to this, and the other by an ordinary T-joint to one of the principal conductors. The space which in this cable is taken up by the fourth wire, would in an ordinary three-core cable be filled with jute or other worming.—Lond. *Elec. Rev.*, Jan. 10.

ELECTRO-PHYSICS AND MAGNETISM.

Sparking in Dielectrics.—BAGART.—A description of a general method of producing sparks in electrolytes in a simple and certain manner. He reduces the exposed surface of the electrodes to a small amount by using thin wires, cased in ebonite, up to near their ends. To produce the discharge he uses two Leyden jars, whose internal armatures are joined to an influence machine, and to the two branches of an exciter immersed in a liquid. This liquid maintains by its conductivity the equality of the potentials of the two armatures as long as the charge is comparatively slow. But if the exciter is adjusted for a sufficiently high-spark potential, as soon as there is a discharge of the internal armatures, the sudden discharge which tends to take place between the external armatures cannot take place by simple electrolytic conduction, and a spark breaks across the dielectric.—*Comptes Rendus*, Dec. 9; abstracted in Lond. *Elec.*, Jan. 3.

REFERENCE.

Electrostatics.—POMEY.—A purely mathematical article on a special case of electrostatic equilibrium, that of two parallel circular cylinders of different diameters.—*L'Eclairage Elec.*, Dec. 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Chemical and Electro-Metallurgical Industries.—J. B. C. KERSHAW.—The conclusion of his serial. He deals with Switzerland, Russia, Austria, Italy, Spain, Norway and Sweden. With the exception of Russia, all these countries are well provided with water power. At Sarpsfos, in Norway, power is sold to the two carbide plants for $11.50 per ehp-year, and at Hagnek, in Switzerland, the ehp-year is sold for $12. In the other countries the outlay on water-power installations has been higher. At Paderna, near Milan, where 13,000 hp has been developed, $28.80 is charged per ehp-year, but this is still much lower than the cost of steam power in Italy. Austria has at Hallein a cellulose and wood pulp factory where 20 tons of bleached pulp are produced per day. The process of C. Kellner for the production of alkalies, chlorates and bleach does not seem to have been successful. Calcium carbide is made at several places. Of interest is the statement that at Aussig a company is working the bell or gravity process for the manufacture of alkalies and bleach with success, and that with 600 hp an output of 8 tons per day has been obtained. The only electro-metallurgical industry which has developed to any extent in Italy, is the manufacture of calcium carbide. An interesting development is the proposal to use the electric furnace for smelting iron ores, and for the direct production of steel in one operation. The Stassano process was tried near Rome, upon a small industrial scale, in 1899 and 1900, and the results obtained in the preliminary trials are said to have justified the erection of a large plant at Darfo in northern Italy, where 1500 hp is available. An output of 4000 tons steel per year is expected. If the steel produced in this way can compete in price and quality with that manufactured by the older methods, the Stassano process is likely to extend rapidly in Italy. At Rome and Milan hydrogen and oxygen gases are produced upon an industrial scale by electrolysis of dilute solutions of caustic alkali. The gases obtained in this way are compressed and sold in steel cylinders of the usual type. The most successful electro-chemical industry yet developed in Norway and Sweden is that of the manufacture of chlorates. There are also carbide plants, a wood pulp factory, and experiments are proceeding in the reduction of iron ores and the direct production of steel. Russia has three copper refineries, three alkali plants and one carbide plant. Spain has one

carbide plant and one alkali plant. Switzerland has plants for the production of chlorate, aluminum, carbide, alkalies and chlorine. In conclusion it is said that the new electro-chemical and electro-metallurgical industries may at no very distant date represent a greater aggregate of ehp than all the lighting and traction stations now in existence. An estimate of the power utilized in 1900 gave an aggregate of 215,000 hp, and this total will undoubtedly grow with each succeeding year. But speculation, over-capitalization and over-production in practical industries must be guarded against.—*Elec. Rev.,* Jan. 11.

Electrolysis of Fused Salts.—LORENZ.—An article in which he discusses the differences between his and Garrard's theories of the electrolysis of fused lead chloride. Garrard, on measuring the decomposition voltage of fused salts of the type of chloride of lead, found two kink points at 0.8 and 1.2 volts, and concluded that such salts are doubly dissociated—in the one case into one bivalent positive Pb ion and two monovalent negative Cl ions; in the other case into one monovalent positive Pb Cl ion and one monovalent negative Cl ion. According to Garrard these two reactions correspond to the two kink points in the curve found by him. On the other hand, according to Lorenz's theory, the second kink point at 1.2 volt, corresponds to the decomposition of lead chloride in one bivalent Pb and two monovalent Cl ions, while the first kink at 0.8 volt is caused by polarization phenomena due to the diffusion of "metal fog," as has been noticed at length before in the Digest. He discusses both the rival theories and points out the facts which are in favor of his view. He is of the opinion that practical results speak well for his theory. With the help of it many observations can be easily explained. The advantage of cooling the cathode and of the use of certain additions to the fused electrolytes are apparent, in that they diminish the solubility of the metal and also the tendency to form "fog." Hereby, in accordance with his theory, the depolarization is diminished and the current yield increased. It also explains why the use of high-current density—in spite of this being contrary to the cooling principle—is recommended. "The velocity of depolarization must be nearly constant in the practical cases of electrolysis of fused salts. It follows that the current yield must be increased by depositing a large number of ions in the unit of time, and in a small space, in which only a small surface is presented to the solvent. This, however, means using a large current density."—*The Elec. Chem. and Met.,* Dec.

Electrolytic Deposition of Copper.—SAYER and SPIERS.—A continuation of their article. They deal with the influence of impurities in the electrolyte in the process of copper refining. The crude metal anode contains two kinds of impurities: First, the less electro-positive elements, which form insoluble slimes and which include gold, platinum, silver, lead, bismuth, tin, antimony, selenium, tellurium; second, the more electropositive elements which go into solution, as iron, zinc, nickel, cobalt, arsenic, antimony, etc. Arsenic dissolves until the bath is saturated after which, if such a stage be reached, it deposits as a slime on the cathode. Antimony first goes into the anodic slime, but eventually redissolves. Both, arsenic and antimony, in neutral or nearly neutral baths, may form cathode sludges consisting of salts of their respective acids. Iron, zinc, nickel and cobalt all go into solution as their respective sulphates. Four methods are briefly described for purifying the electrolyte from arsenic, antimony and bismuth. To obtain the deposited copper quite free from antimony, great care must be taken that but the merest trace of the latter should be in solution. The separation of zinc, nickel and cobalt from the solution is much more troublesome, and their presence is much more harmful, for their presence not only makes the solution relatively poorer in acid, but also relatively poorer in copper. It is very important when a stage is reached at which the concentration of the impurities becomes considerable, to keep the decomposition voltage below that capable of depositing the foreign elements, which, even if their presence were not otherwise harmful, nevertheless render the deposit limp and brittle. The effect of chlorine in the solution is to discolor the copper; 6 cc. of hydrochloric acid in a liter of saturated copper sulphate renders the copper quite black. According to Swan, a most remarkable effect is produced by the addition of a minute proportion of a solution of gelatine in dilute nitric acid to an ordinary copper sulphate solution composed of two-thirds saturated solution with 5 per cent of sulphuric acid. If so much of the gelatine solution as represents 1 part of gelatine to 30,000,000 parts of the copper solution be added instead of the deposit being pliant and crystalline, it will, under the proper condition of temperature and current density, be smooth, bright and elastic, and if the gelatine be in excess, the deposit will be extremely hard and brittle.—*The Elec. Chem. and Met.,* Dec.

Instantaneous Chemical Reactions and the Theory of Electrolytic Dissociation.—KAHLENBERG.—A brief abstract of a paper read before the Am. Chem. Society. The oleates of the metals are soluble in perfectly dry benzine, and from these solutions the anhydrous chlorides are instantly precipitated by a dry benzine solution of hydrochloric acid. These solutions in benzine are practically non-ductive of electricity, consequently electrolytic dissociation cannot be supposed to have taken place, yet the reactions appear to be exactly parallel to those in aqueous solutions which the advocates of the electrolytic dissociation theory have tried to explain as being due to the action of ions.—*Science,* Jan. 24.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Limitations of Wireless Telegraphy.—A long and rather sarcastic editorial. "There are many competent to form an opinion who consider that Mr. Marconi was deceived in believing that he heard faintly in a telephone the expected signal from Cornwall; but even admitting that he can telegraph the entire Morse alphabet, his difficulties are only commencing." If he commences with one station at each side of the Atlantic, there will be the following difficulties: "The enormous power used for that long distance will probably make it impossible to send more than four, or at most, five, words per minute. The great height of his poles will expose him to frequent interruption from storms, and he will be liable to have his signals rendered illegible at any moment by the ether waves sent off from any ocean liner using the same wave-length, and happening to be comparatively near either of his stations." In order to increase the volume of traffic it will be necessary to erect more stations on either side, using these in pairs, with a special wave-length for each syntonized pair of stations. "As a matter of practical experience there are not more than 10 tones which can be used simultaneously with syntonized apparatus without mutual intreference. It comes to this, then, that the greatest number of stations Mr. Marconi can erect for transatlantic signaling would be 10 stations on either side, these possibly giving conjointly a maximum of 50 words per minute." But in doing so, "he will have succeeded in damaging all his useful marine intercommunication from ship to ship and from ship to shore," and this is really the most valuable application of wireless telegraphy. Moreover, there will be no secrecy. All over Europe it will be possible to "tap" messages sent from England to America. When other countries proceed in the same way in erecting wireless telegraph stations, there will be endless confusion. At the end of the editorial the writer imagines that for the last 50 years or so no submarine cable existed, but all communication across the Atlantic was wireless by ether waves. If now a discoverer would arise, bringing forth the gutta-percha submarine cable, "with what rapturous delight would that new invention be hailed the whole world over! The electric cable—that takes the message straight to its destination, and does not allow it to be scattered in all directions—the speedy, certain, secret electric cable! What a marvelous improvement upon the ether wave! A new era for telegraphy is inaugurated, and ether telegraphy is doomed."—Lond. *Elec.,* Jan. 17.

Photographone, or Electric Arc Kinematograph.—RUHMER.—A description of a very interesting new instrument. The speaking arcs of Simon and of Duddell have induced him to turn the Kinematograph on the arc. The arc is produced between two horizontal carbons on a 220-volt circuit with resistance in series. The arc circuit further comprises an induction coil and a microphone or a liquid interrupter in a shunt, thus intermittent currents are superposed upon the continuous current. In front of the arc is a slit, further off is the kinematograph. The slit produces an image of the two carbons on the ground glass. When the kinematograph is in motion, the arc appears as a bright, continuous band. When the arc hisses the band becomes wavy. The liquid interrupter cuts the band into rectangles of varying lengths. When the experimenter whistled into the microphone some 1500 vibrations could be counted on the band of the arc image. He finally talked into the arc, the apparatus being so arranged that a lens produced an image of the steady arc in the shape of a very fine bright line running right across the film, which was traveling at the rate of 3 meters per second. To reproduce the impression thus obtained, he uses the same box camera, with its two pulleys, the upper one of which is rotated by an electric motor. But the arc now serves as the projector lamp, and the film travels with the same speed as during the exposition, in front of the selenium

cell of high sensitiveness. The variations in the light intensity of the photo-phonogram are then converted into variations in the resistance of the selenium cell and of the current intensities in its circuit, and speech is reproduced in two telephones coupled in series, with surprising distinctness.—*Ann. d. Phys.*, 1901, v. 5, p. 803; abstracted in Lond. *Eng'ing*, Jan. 3.

MISCELLANEOUS.

Size and Weight of Spheres.—Appleyard.—A brief article. In a former article he described a simple method for calculating the change in weight of a wire, corresponding to a definite small change of diameter. He had shown that "for any given material a constant can be found which, when multiplied by the number representing the diameter of a given wire in mils, expresses the weight in the change of unit length of the wire in pounds." This "mil-constant" is used by manufacturers as a ready means of determining the error in weight of wires, produced by an error in the die, or by the stretch, in the process of drawing or covering it. Conversely, it enables cable makers, from the actual weight of a trial length, to calculate by simple division the corresponding number of mils, to be added or deducted from the next run of work, in order to attain accuracy of weight. In the present article he applies the same principle to the manufacture of spheres and shows that the "mil-constant" may be of valuable aid, especially in the design of dies and other tools intended to produce spheres of given gauge and weight.—Lond. *Elec. Rev.*, Jan. 3.

REFERENCES.

Visit of British Electricians to Germany.—A reprint of the report of the committee on traction, light and power distribution, from last year's visit of the Brit. Inst. of Elec. Eng. to Germany. The report deals with ownership of works, prime movers, boilers, generators, motors, storage batteries, cables, tramways, the experimental high-speed railway, and the Langen suspended railway in Elberfeld.—Lond. *Elec.*, Jan. 10.

Decimal System.—Raverot.—An illustrated article on the decimal system and the measurement of time and angles.—*L'Eclairage Elec.*, Dec. 28.

New Books.

Instruments et Methodes de Mesures Electriques Industrielles. By H. Armagnat. Second Edition. Paris: C. Naud. 614 pages, 230 illustrations. Price, 15 francs.

The first of the three principal parts into which this volume is divided treats of laboratory apparatus and standards. The matter is of the kind that would naturally be expected, i. e., dissertations on various types and forms of galvanometers, the best form of their coils, the use of shunts and the making up of standard cells and resistances. There is also a section of brief but instructive notes on the installation of galvanometers in places where vibration is present.

Part II. concerns commercial measuring apparatus, such as indicating voltmeters and ammeters, integrating meters, etc., and cannot be said to be very complete whether taken as a review showing the evolution of types or as a description of modern apparatus.

It would seem that the author's plan has been simply to mention the fundamental principles underlying the different classes of meters, but even then it surely does not seem to be expecting too much to ask that the D'Arsonval type of instruments, for instance—among which the form adopted by Weston stands prominent—should be exemplified by other than a few lone illustrations of a primitive form of a French instrument with four brief pages of descriptive matter; and the almost endless varieties of electromagnetic meters so extensively used abroad and lately brought to a high degree of perfection by Lord Kelvin, should be entitled to more mention than is given by three pages and three outline cuts showing no make in particular. True recording, or, as they are called in France, registering meters, i. e., the kind that make graphic records, are still more cavalierly handled, and when we come to integrating meters we find that this line, in which there is at the present day perhaps greater activity and a greater variety of types than any other, is illustrated by the little-known O'Keenan type, the Thompson, an A. E. G., an Aron, and the old type Shallenberger instruments.

The third and last section of the book is on methods of measurements of not only electrical but magnetic units. For information regarding the former the reviewer would prefer to turn to his Kempe, but for the latter the present volume assembles in a convenient form much matter that is ordinarily to be found only by searching through scattered volumes.

Taking it all in all, while the book is probably not the one that would be selected by an engineer were he restricted to but a single volume on the subject, it has a place in every well stocked library, perhaps as much because of the information it gives on European practice as for any other reason.

Elektrische Kraftubertragund und Kraftverteilung. By C. Arldt, Chief Engineer, Allgemeine Elektricitats-Gesellschaft. Berlin: Julius Springer. 387 pages, 257 illustrations. Price, 4 marks.

This is the third edition of a novel form of catalogue illustrating the dynamos, motors and auxiliary apparatus made by the Allgemeine Electricitats-Gesellschaft, of Berlin. Instead of being a price list pure and simple, the book has been written along elementary text-book lines, numerous ingenious if not always strictly accurate analogies being made use of to make clear to the non-technical reader the general subject of the use of electricity for transmitting and distributing power. Of course, A. E. G. apparatus is the only make illustrated or mentioned, but their line is so extensive that the scope of the work is not narrowed by this course. Probably the most interesting matter of American readers will be the hundred-odd pages showing the application of both direct and alternating-current motors for driving various machines and tools. Induction motors seem to be freely used even for such work as driving lathes, milling machines and cranes, for which in this country direct-current apparatus has been by some engineers considered essential.

In the book are found full sets of tables giving the important dimensions of all standard sizes and types of A. E. G. dynamos and motors and a brief, but very interesting and valuable section giving in detail the approximate amount of the purchase and installation costs of the boilers, engines, dynamos and accessories for small isolated plants of from 6.6 to 100 kw capacity.

The volume should help the Allgemeine Electricitats-Gesellschaft to effect sales, and their idea is one that it would seem could be followed to advantage by our manufacturers.

BOOKS RECEIVED.

Wireless Telegraphy. A Popular Exposition. Second Edition. By C. W. Tunzelman, B. Sc. London: Office of Knowledge. 104 pages, 30 illustrations. Price, 1 shilling 6 pence.

The Electric Installation of the Natural Food Factory at Niagara Falls, N. Y.

By Arthur B. Weeks.

All observing visitors to Niagara Falls will note at once the immense modern structure of buff pressed brick, occupying a prominent and beautiful site at the upper end of the State Reservation, and attracting much notice and favorable comment because of its great size and architectural beauty. This is the plant of the Natural Food Company, manufacturing the widely known Shredded Wheat Biscuit. This factory, one of the latest consumers of Niagara Falls power, possesses a unique and ingenious electric installation, complete and up to date in every particular, including both direct and alternating current, storage battery, a miniature electric railway, private telephone and telegraph wires, and specially designed machinery for each of the many processes by which their product is prepared for use.

There are two transformer rooms, designated as the east and the west, current being received into the east transformer room from the power house of the Niagara Falls Power Company, at 2200 volts, two-phase, through the panel shown in Fig. 1. This panel has the Westinghouse leaf contact circuit breaker, with flat carbons to receive the arc. The switches are double-bladed and make sufficient and positive contact, obviating entirely one objectionable feature of some switches, which work loose in the lower connections, and, when closed with the long, hardwood lever hooking into the eye at the upper part, frequently slip along the outside of the switch jaw, instead of entering properly. Below the breakers are integrating wattmeters.

Static transformers step down the current from 2200 to 110 volts for lighting, and to 440 volts for power purposes. Fig. 2 shows both high and low-potential panels for power and lighting circuits. One

of the features of this switchboard is its ground detector. All contacts and connections are upon the back of the switchboard, and from this a rod passes to the front of the board and is attached to the operating handle, which carries an indicating pointer over a dial plate. If a ground appears upon any conductor of the two-phase system, it is so indicated upon a voltmeter. Fig. 3 illustrates this attachment, and shows in detail the wiring and connections for the voltmeter switch and ground detector. Figs. 4 and 5 show the lighting boards of the east transformer room. The power panels are of the same design. At the left is the high-tension panel, with marble

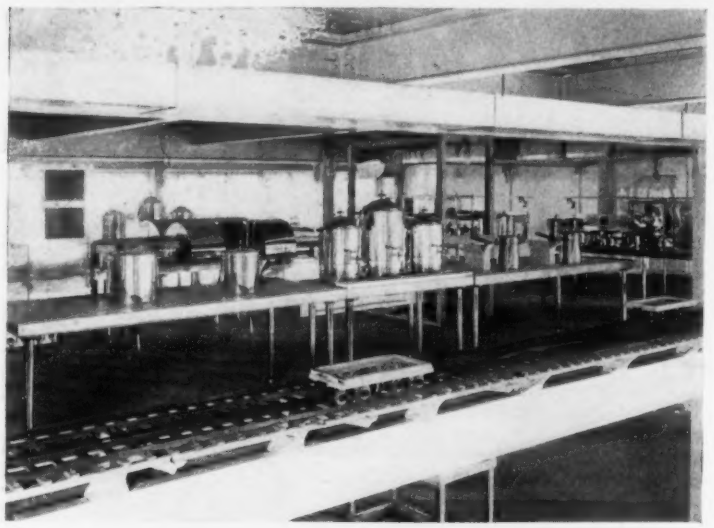


FIG. 11.—ELECTRICAL KITCHEN AND RAILWAY.

barriers between the single element knife-blade switches and lignum vitæ fuse box. A rear view of this switchboard is shown in Fig. 6.

In this east transformer room is also a Westinghouse 150-kw rotary converter (Fig. 7), producing 220 volts on its direct-current side. The current thus generated is used in operating four electric elevators, of double screw Otis pattern, of the style used in the Electric Tower at the Pan-American Exposition. This rotary converter represents the latest design of Westinghouse make, having many improvements. The induction motor for starting is of a size sufficient for bringing the armature up to synchronism without overheating, and its current can be taken from any source for either side of the starting switch. One side may be used for starting, and the

FIG. 12.—ELECTRIC RAILWAY.

other thrown to the opposite side for running. The round meters at the top are alternating-current ammeters for each phase. The field rheostat is placed upon the rear of the panel, there being no available space upon the direct-current board. This field rheostat, after the rotary has been synchronized, is not used for the regulation voltage. It is possible to vary the voltage about 10 volts by means of the rheostat, yet it is only used to acquire the proper power factor. What little regulation of voltage may be necessary is accomplished by means of an alternating-current regulator, connected to each phase in the primary circuit. Instead of the four-plug switches for the motor and four for the alternating-current side of the rotary as formerly made, both phases for each are controlled by one lever, simplifying materially the operations of stopping and starting. To the left of this panel are shown the white dial and pointers of the Lincoln synchronizer, described in a recent issue of this journal. The direct-current panel at the right has the usual equipment for the direct-current side of a rotary transformer.

In the west transformer room is another electric equipment. Here is a Holtzer-Cabot generator, shown in Fig. 8, of 12 kw capacity, 30 volts, 400 amperes, speed 710 revolutions, and driven by a Westinghouse induction motor, 10 hp, 400 volts. This motor generator set is used for charging storage batteries for telephones and annunciators, and for operating the miniature electric railroad. The right-hand panel of the board (Fig. 9) shows the generator set instruments, the other panel being reserved for the numerous battery circuits. In this transformer room are two switchboards of the same design as those of the light and power panels in the east transformer room. Fig. 10 shows one of four risers located in appropriate places between the walls from basement to sixth floor. The space on the right is to be used for future additional installation. The running of the lead-sheathed cables and other wires is done in the most thorough and

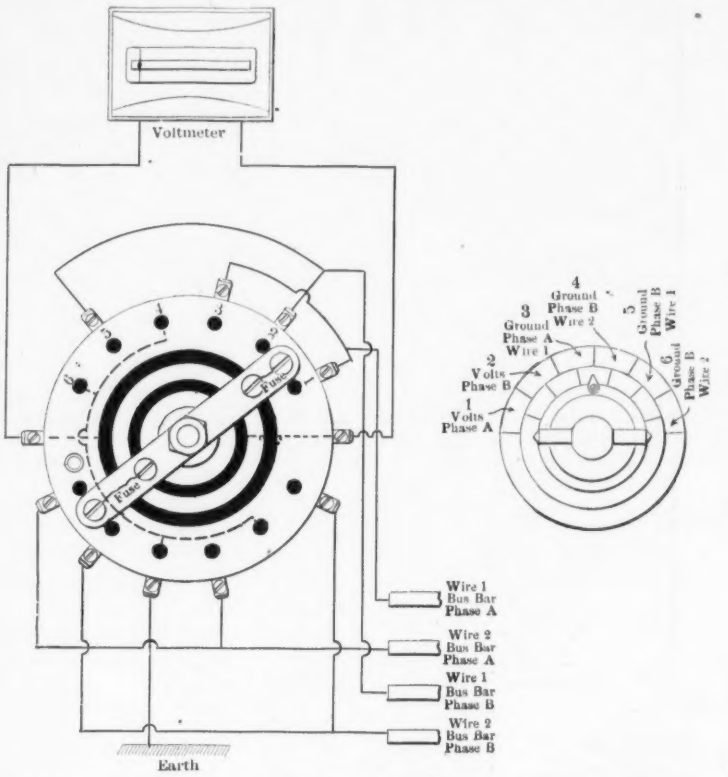


FIG. 3.—WIRING DIAGRAM OF VOLTMETER SWITCH AND GROUND DETECTOR.

approved manner, every precaution being taken to prevent short circuit. Cabinet cut-outs are placed at convenient points throughout the building.

In this great building, containing 5½ acres of floor space, there are to be 130 motors used. The individual motors are all of Westinghouse induction type, and located, some on the floor and others on the ceiling, according to the nature of their office. They are built for three rates of speed—1700, 700 and 470.

One of the most complete electrical kitchens in the world is shown in Fig. 11, and it is as unique as many other details in connection with the Natural Food Company's plant. It is located upon an arched bridge which spans the rotunda of the main floor from gallery to gallery, and here are prepared for demonstration the innumerable "shredded wheat biscuit" dishes. All heat for cooking is supplied by electricity.

Around the balcony of this main floor runs the miniature railway, fully equipped with tracks, switches, stations and guards, for the purpose of serving dainty luncheons to visitors. The guest seats himself at what seems to be a small white table, but which is in reality one of the tiny cars of this ingenious little railway (shown in Fig. 12). A desk at the left of each seat contains a menu card from which a luncheon may be chosen and noted on an order slip. An electric but-

ton is then pushed, which lights a tiny lamp on a switchboard in the kitchen, indicating that at a certain station some one is waiting to be served. The switchboard operator closes the switch in connection with this station, and the car immediately starts off and proceeds directly to the kitchen. The order completed, the car moves back automatically to the station from which it started, bearing the luncheon attractively served, and itself serving as a dainty table for the convenience of the visitor. There are no wrecks on this railway, the block system used preventing all disasters. Fig. 13 shows the switchboard in connection with the miniature railway service.

Looking out on the upper Niagara River at the front of this great building, is a dining hall for women operatives, an immense, brilliantly lighted apartment, tastefully furnished with circular tables, comfortable chairs, and an open piano. Artistic tiled fireplaces lend attractiveness, and an important and interesting feature of the room is the electric cooking equipment, shown in Fig. 14, and occupying prominent positions on either side of the entrance. Here are tables fitted with the most approved electric cooking utensils, coffee and tea urns, chafing dishes, and so on, while at one side stands a row of covered compartments heated by resistance coils placed within lengths of pipe, over which food may be kept hot. In the electric kitchen a very complete electrical cooking equipment is in operation, and appetizing dishes of various kinds are served to employes.

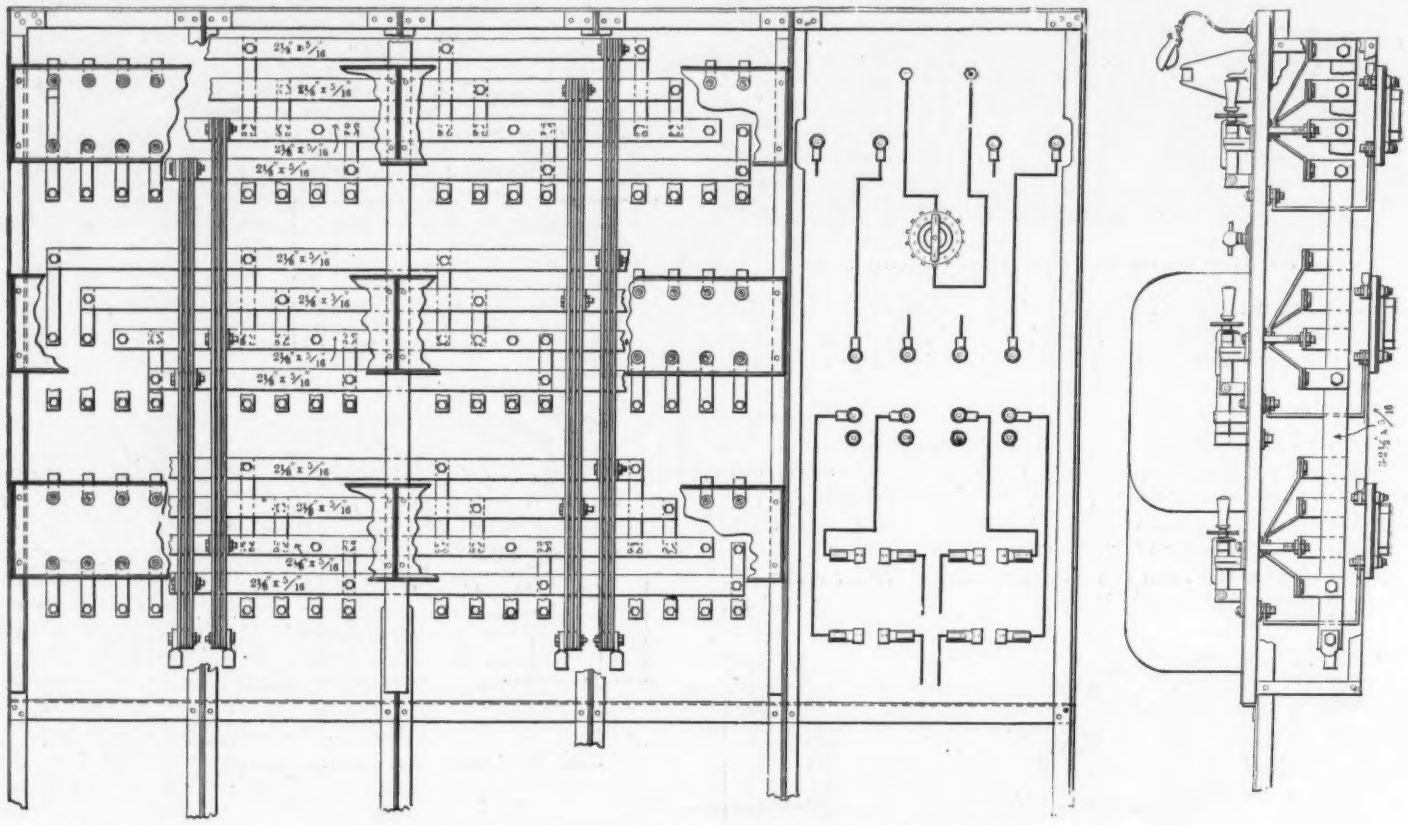
Below this dining hall is a large and well furnished lecture room, in the wall at the back of which is an electrical device for operating a stereopticon. A 220-volt direct-current lighting circuit, and another of alternating current, occupy enclosed chambers beside it, and corresponding ones are stationed in the floor of the lecture platform for use in any lecture requiring the demonstration of electric cooking or other devices. The lighting is artistic and beautiful, the electric candelabra consisting of chain pendants supporting incandescent lamps in groups.

The offices and building throughout are heated with hot air. A unique device in each office regulates the temperature and air for ventilating purposes; a valve automatically controlled admitting hot air and shutting off cold, or vice versa, according to a predetermined temperature. Air for ventilation is supplied by fan blowers 16 ft. in diameter, the entire air supply being renewed every 7½ minutes. In the offices are plug receptacles placed at different points along the walls, to which the individual telephones may be instantly transferred, should a change in the location of desks be desirable, and receptacles for electric desk lights and messenger service calls are also stationed in different parts of the room for the same purpose.

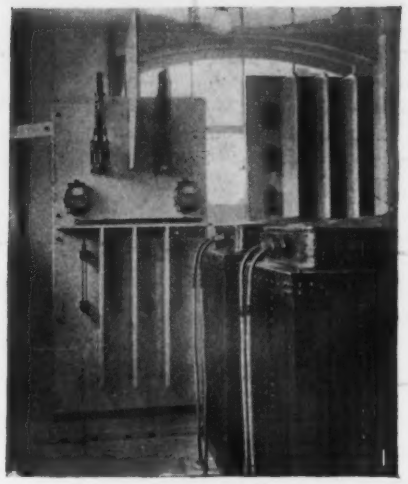
The manufacture of shredded wheat biscuit, for which purpose this great plant with its intricate and specially contrived machinery has been devised and erected, is an interesting process. Every step, from the receiving of the grain to the loading of packed cases for shipment is carried on under this extensive roof. The wheat, when unloaded from the wagons on the ground floor, is carried upward by chain conveyors to vast hoppers, where, by a fanning process, motor operated, it is thoroughly cleansed. It then descends through a long, box-like chute to a rubber belt, 14 inches wide and slightly concave in the center, which carries it in a continuous stream through a long, narrow tunnel to the cooking room, shown in part in Fig. 15. Here the wheat is placed in immense cylindrical "tumblers," which are lowered by an electric crane into great vats of boiling sterilized water, in which the open-work, wheat-filled cylinders are revolved for 30 minutes by a geared induction motor, at the end of which time the grain is thoroughly cooked. The electric crane, made by the Case Manufacturing Company, of Columbus, Ohio, is of 2000 lbs. capacity, operated by three induction motors, one running north and south, one east and west, and the third for hoisting.

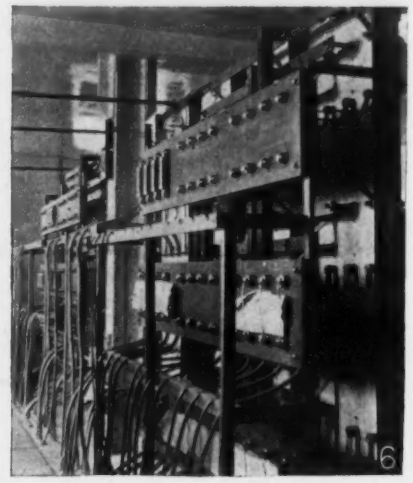
Current is conducted to the crane by four bare wires, and taken off for the motors by contact rollers. From the rollers the current is conducted to the operator's platform and connected to an auto-starter and the several switches that control the movements of the crane. Each operating two-phase switch is double-throw, giving a certain movement when closed on one side, and the reverse direction when the opposite side is closed. The slow revolution of the cylinders of wheat in the tanks of boiling water is obtained through a set of reducing gears. The motor is placed upon the floor, and clutches are used to control each tumbler, or cylinder. From the vats, the moist wheat is carried, still smoking hot, through chutes to the next room, where it is spread out in large, oblong cases lined with white cotton cloth. It is left there 12 hours, being turned eight times, and is then free from moisture and ready for the next process—that of shredding.

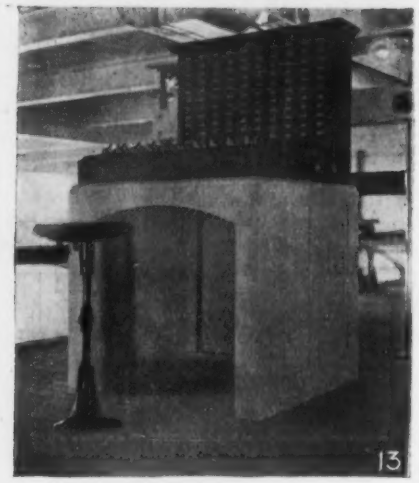
The shredding machines (Fig. 16) consist of 36 small hoppers, into which the cooked grain is automatically run. These stand in a long row and feed the wheat to a device consisting of two rolls, one having a smooth and the other a grooved surface. Pressure between these rolls draws the wheat out into long, fleecy threads, each set forming one layer of the biscuit. Fig. 17 shows a 40-hp induction motor belted to a shredding machine by means of a Renold steel link belt. The

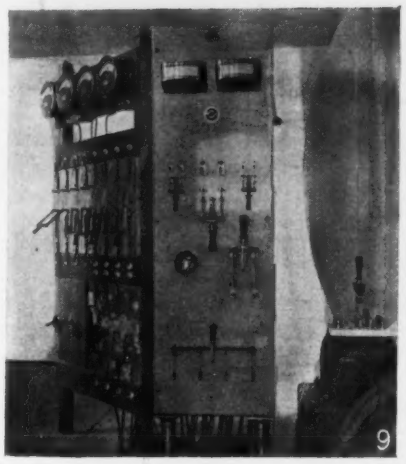


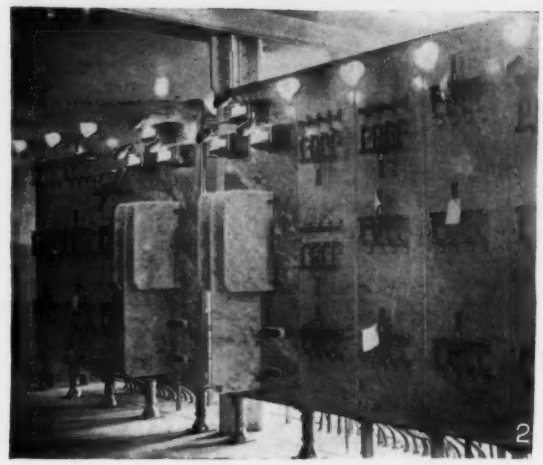
FIGS. 4 AND 5.—DIAGRAM OF REAR AND END OF LIGHTING BOARD.

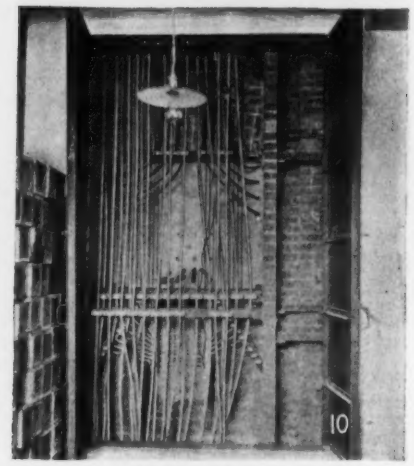


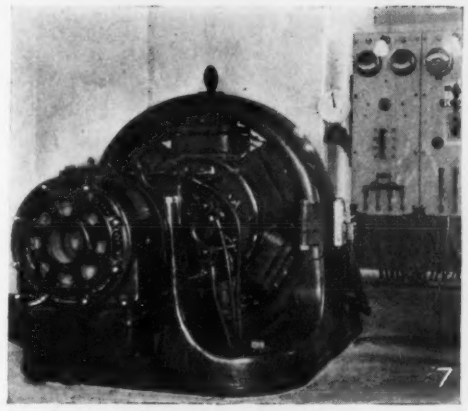


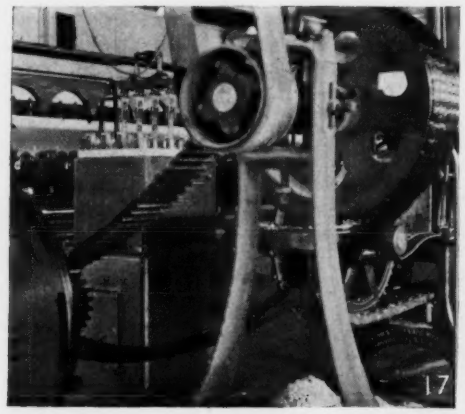


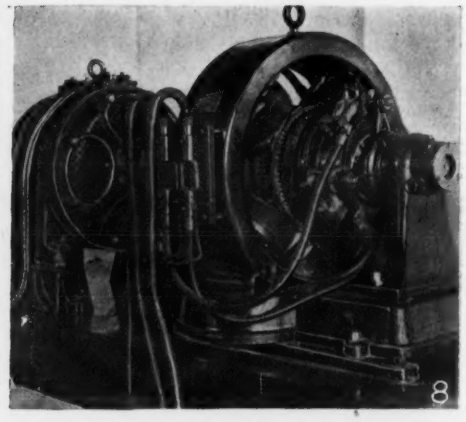


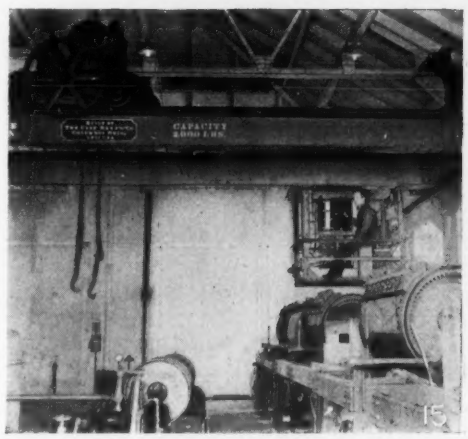


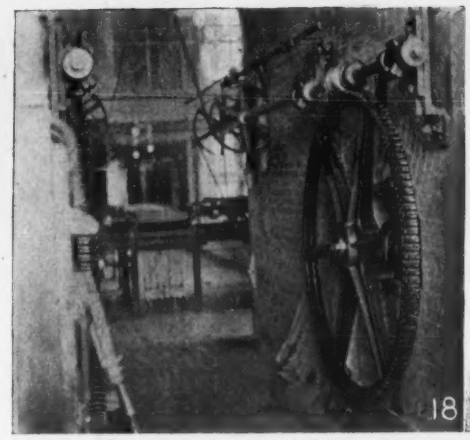












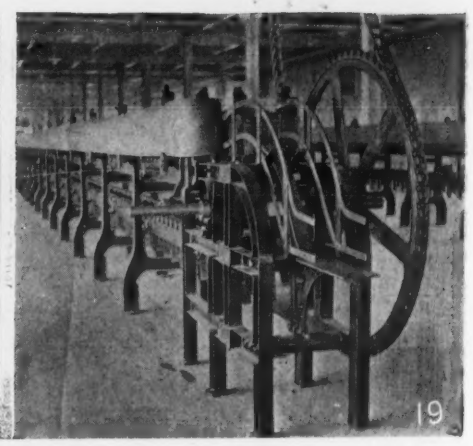


Fig. 1.—Receiving Panel for Niagara Power.
Fig. 9.—Subsidiary Switchboard.
Fig. 7.—Rotary Set.
Fig. 15.—Grain Cooking Room and Electric Crane.

Fig. 6.—Back of Lighting Switchboard.
Fig. 2.—High and Low Potential Panels.
Fig. 17.—Motor-driven Shredding Machine.
Fig. 18.—Ferris Wheel Baking Pans.

Fig. 13.—Electric Railway Switchboard.
Fig. 10.—Risers from Basement to Sixth Floor.
Fig. 8.—Generating Set.
Fig. 19.—Motor-driven Chain Conveyer for Cartons.

ELECTRIC INSTALLATION OF THE NATURAL FOOD FACTORY, NIAGARA FALLS, N. Y.

gear on the shredder has a rising shield on either side to prevent the displacement of the belt. The motor makes 700 r. p. m., and the running of the chain is practically noiseless. The Renold belt, as recently described in these pages, is made up of parallel layers of steel punchings riveted together and free to move on the pin connecting them. The teeth of the chain mesh into the gears, while the outside surface is smooth. This chain belt is similar in construction to leather link belts, with the exception of the teeth. The steel belt is used on motors both on the floors and on the ceilings. That here described was made in England, and installed by the Link Belt Engineering Company, of Nicetown, Pa., who now manufacture it in this country.

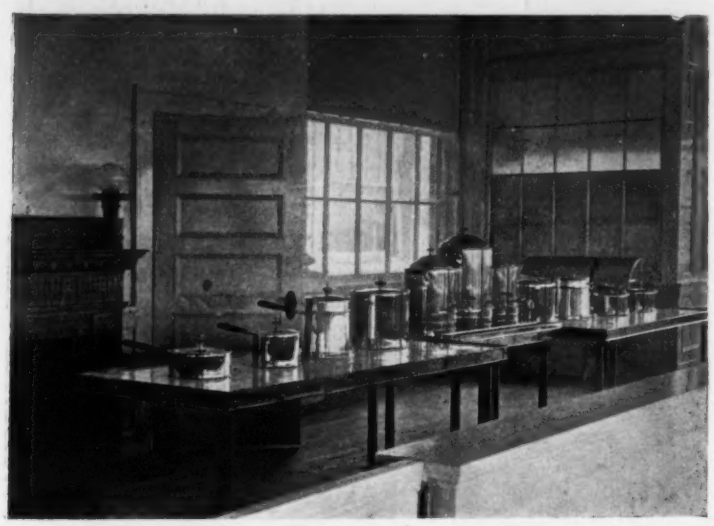


FIG. 14.—DINING HALL EQUIPMENT.

All along the carrying plate on which the shredded wheat is transported from one hopper to the next, are slots, the width of a biscuit apart. When the last hopper has been passed, this plate moves over a set of knives, which, passing upward through the mass of fleecy threads, cuts them into neat, oblong biscuits. Here the biscuits leave the carrying plate and are held up by an air suction until in a certain position above a great baking pan, when a reverse action blows them downward, and the receiving pan moves automatically along to receive the next row in like manner, and so on, until the tray is filled. Another then takes its place, and the filled pan is placed on one of

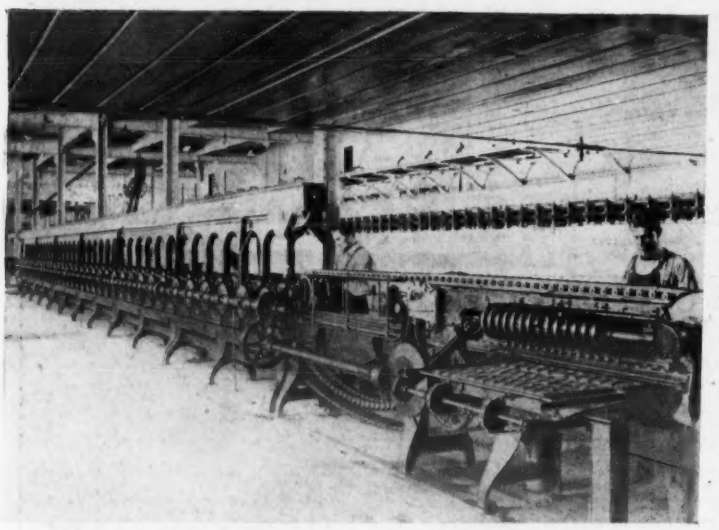


FIG. 16.—ELECTRICALLY-DRIVEN SHREDDING MACHINES.

the shelves of an enormous "Ferris wheel," containing 12 paddles, or shelves, holding eight pans of biscuit each, and revolving in an immense heated oven. Each of these Ferris wheels is operated by a motor-driven worm gear (Fig. 18) placed outside the oven.

When the biscuit have acquired an even golden-brown tint, the trays are passed into a long, hot-air evaporator, containing two rows of 19 shelves each, where they travel slowly through the tunnel-like chamber, taking one and three-quarter hours in transit, and coming out at the farther end, thoroughly baked and delicious. This evaporator is operated by a motor from the ceiling of the room beneath.

The trays are now carried automatically along a rack, down a long table between a double row of young women who pack the biscuit into cartons. At no other time during the entire process are the biscuits touched by hand. The filled cartons are packed in a carrying device resembling a long, narrow ladder, the exact width of the cartons, which lifts them up an incline to the floor above. Here they are passed through an automatic sealing apparatus, and on between two parallel belts down a farther extension of the chain conveyor to the lower end of the room, where they are discharged at the end shown in Fig. 19. By the time their destination is reached, the paste used in sealing is quite dry, and the cartons are ready to be packed in the wooden cases which are coming down constantly through chutes from the nailing room on the floor above. These cases are sent up "knocked down" on a motor-driven conveyor from the ground floor, and are nailed together by automatic nailers driven by induction motors.

For the accompanying diagrams we are indebted to the courtesy of the Crouse-Hinds Electric Company, of Syracuse, N. Y., by whom were furnished and installed the lighting and power panels of this most modern and up-to-date electrical equipment. The electric heating and cooking apparatus was installed by the American Electric Heating Corporation, of Cambridgeport, Mass., Mr. J. I. Ayer giving considerable personal attention to the design and installation. The current is derived from the huge power plant of the Niagara Falls Power Company.

The Moore Telephone System and Apparatus.

The Moore Telephone System, which has been operating for some few years past in the Eastern part of Michigan, and whose lines are connected with those of the Michigan Bell and the independent networks as well, is supplied with apparatus built by the Moore Telephone Manufacturing Company, of Caro, Mich., of which Mr. W. J. Moore is general manager. The apparatus is herewith illustrated.

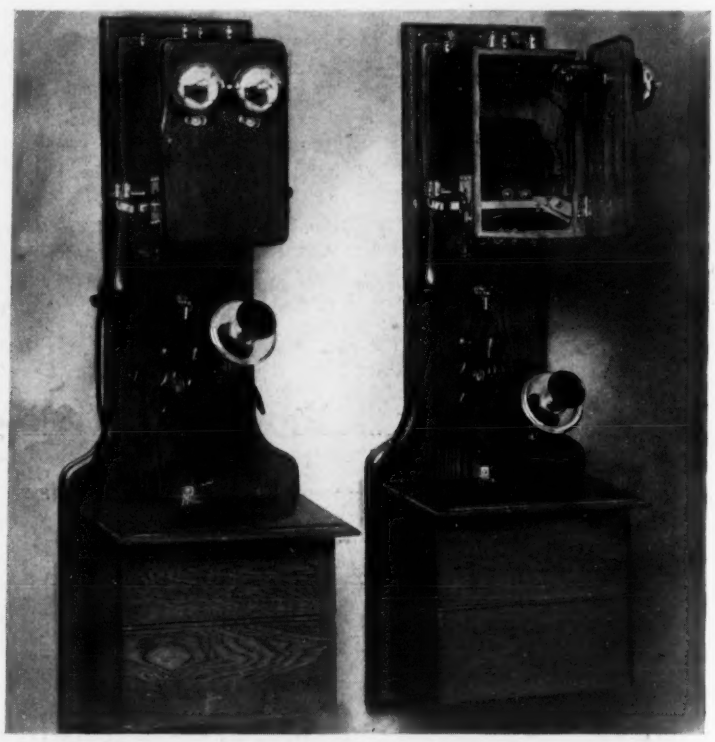


FIG. 1.—TELEPHONE.

In the accompanying cuts, Fig. 1 shows the telephone used, which is made either bridging or for series work. The receiver is multipolar, the switch is of hard-drawn copper, brass and bronze, no castings being used. It is on the lines of the familiar Bell-Watson switch. The ringing apparatus has the generator with either chain or cog gear. The armature is made with a soft laminated iron core and steel shaft. All the woodwork is done in oak. The transmitter is placed on a universal arm. In the cut, on the closed telephone, the transmitter arm is partly in its raised position, while in the open

telephone the transmitter arm is lowered towards its lowest position to show the working of the arm.

Fig. 2 shows the desk set outfit, the principal advantages being

FIG. 2.—DESK OUTFIT.

the placing of an induction coil in a special box (not in the base of the stand) in which the bell is also placed. The connections are so arranged so that it cannot be easily connected wrong, as each binding post has names or numbers stamped on them.

Fig. 3 shows the transmitter and transmitter arm. This arm is so arranged that it holds the transmitter always in the same position. It is enameled in black, with all the trimmings nickel-plated, and makes a very neat appearance. It is arranged to take any transmitter, and has the advantage that it is not necessary to be long in order to be raised up and down as far as it is necessary, but always holds the transmitter in the same *vertical* position.

The Moore transmitter does not use granular carbon, but instead employs small balls. The face piece is of turned brass (not pressed nor spun), the diaphragm is carbon, as Mr. Moore believes that as good results cannot be obtained with the metal diaphragm.

Fig. 4 shows the repeating coil, with the coil which goes in the box

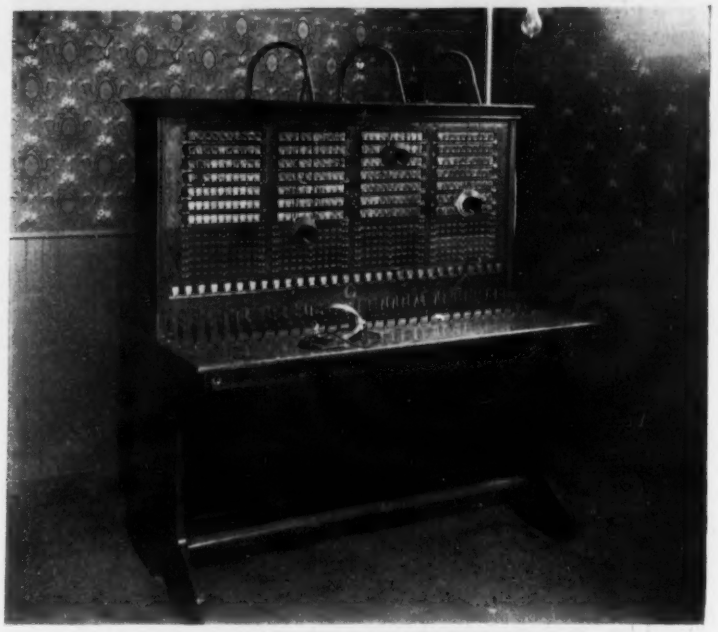


FIG. 8.—SWITCHBOARD.

lying on top. This coil is fastened in the box with brass straps or sealed in paraffine wax preferred, and is wound to any resistance. Fig. 5 shows a bank of 10 drops, such as are used in the Moore switchboards. The drops and other switchboard apparatus are made to cater to the requirements of small exchanges of 300 drops or less,

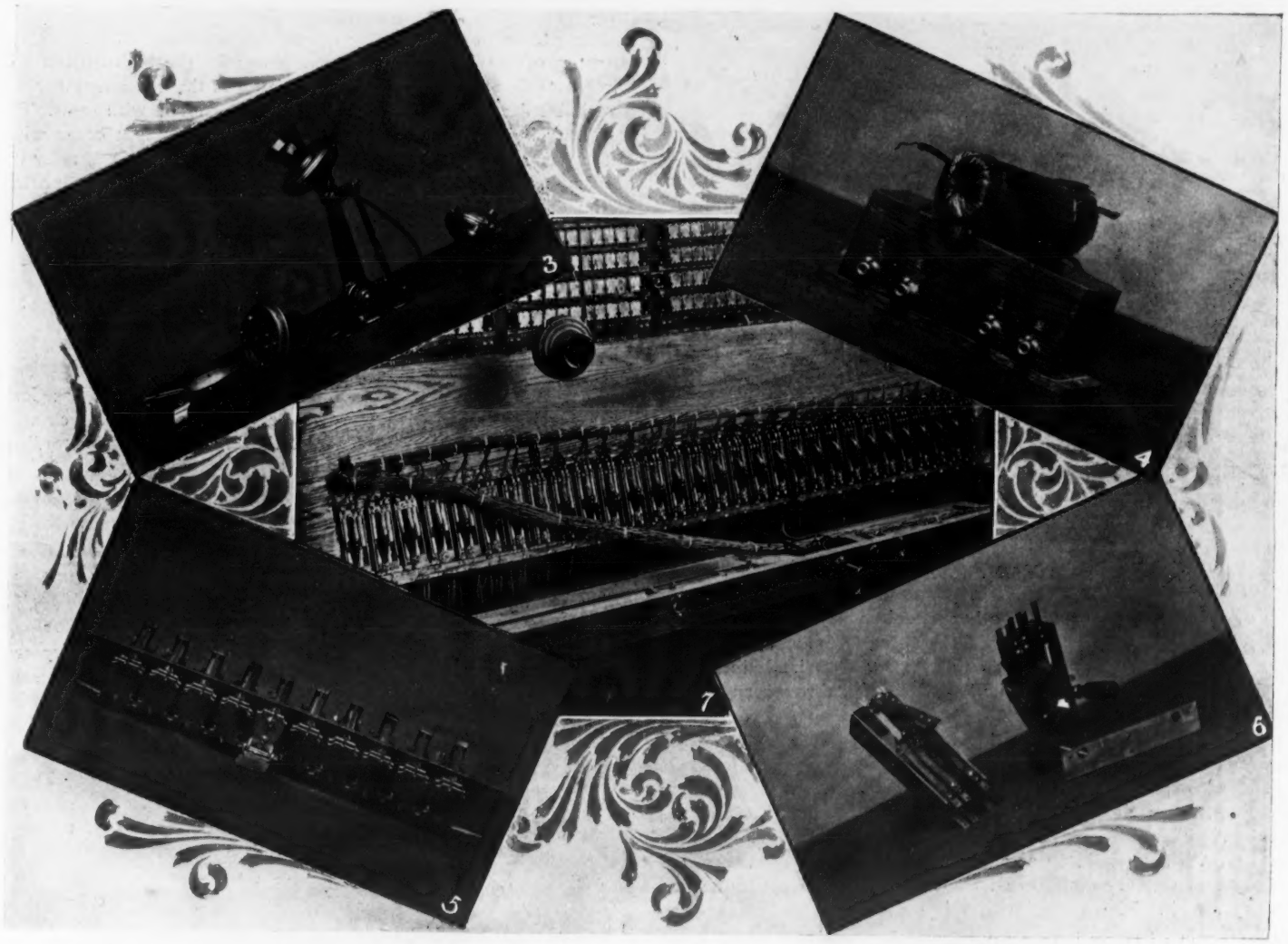


FIG. 3.—TRANSMITTER AND TRANSMITTER ARM. FIG. 4.—REPEATING COIL. FIG. 5.—BANK OF TEN DROPS. FIG. 6.—RINGING AND LISTENING KEY. FIG. 7.—BOTTOM OF KEYS IN BOARD.

and are simplicity itself. The shutters are very heavy, assuring positive night bell connections. The coils are hand-wound, and the drops are said to be better for small boards than those made for use on large as well as small switchboards. The jacks are also put up in banks of 10.

Fig. 6 shows the ringing and listening key. All contacts are rubbing contacts. There are only eight contact springs on it. It will ring either plug, and will not continue to ring when the lever is released. With it there are no metal parts exposed on top of the table, not even a screw. Fig. 7 shows the appearance of the bottom of the keys as they appear when placed on the board, while the upper appearance of the table may be seen in Fig. 8, which shows the largest Moore switchboard made, and was photographed while in actual operation. These switchboards are made in sizes from 10 to 300 drops, the company making this range its special field of occupation. It will be gathered that improvements and advances in all this apparatus have come directly as the fruit of experience gathered during six years of active manufacturing and exchange work since 1896.

Protection of Secondary Circuits.

That without suitable protection secondary alternating-current circuits may be a source of danger, cannot be denied. The ordinary transformer primary fuse, in case of failure of insulation between the secondary and primary will lead to a short circuit in one of the coils, thereby increasing the primary current and blowing the fuse, but this action may sometimes fail. Ground shields are sometimes provided—that is, a conductor interposed between the primary and the secondary and grounded so that the primary current necessarily makes connection with this shield before reaching the secondary circuit; and in like manner the secondary itself has either been permanently grounded or arrangements have been introduced between it and the ground, which, under the abnormal increase of potential due to the failure of the insulation between the two coils, would short circuit, causing a ground. To a certain extent this protection is successful in that it lessens the risk consequent upon touching the transformer or the secondary circuit. It, however, causes a dead ground upon one side of the primary line, and thereby increases the danger throughout the

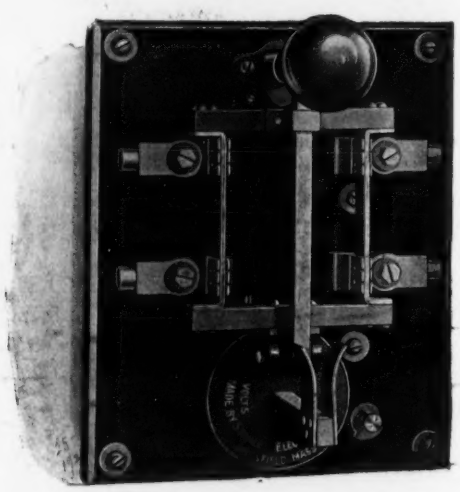


FIG. 1.—SECONDARY PROTECTOR CLOSED.

rest of the system, since all the other transformers in the system are subjected to abnormal strains, and the risk of coming into contact with the live side of the circuit or other transformers is increased. To insure entire safety, when the high potential, through any cause, becomes connected to the secondary wiring, the injured transformer should be disconnected from either the primary or secondary wires, or both.

The accompanying engravings illustrate the S. K. C. secondary protector, otherwise known as the "sneak current detector and breaker." This combination contains an electrostatic device in connection with a solenoid so arranged that a connection between secondary and primary operates an automatic switch opening the secondary circuit. The operation of this combination is entirely positive and can be relied upon with implicit confidence.

On 1000-volt lines the automatic switch will operate when there is ground on one side of the primary and the transformer is broken down on the other side. On 2000-volt (or over) lines, the automatic switch will operate as soon as the transformer is broken down, whether there is or is not a ground on the primary. Depending upon an electrostatic device for its operation, the secondary protector consumes no energy except momentarily at the instant of operation. The shunt circuit through the solenoid is opened when the automatic switch opens.

On the first page of the *New York Times* of July 21, 1901, there appeared an article headed "Incandescent Lamp May Cause Death," dealing with certain testimony given before a coroner's jury on the subject of dangers incident to the use of alternating current for house lighting.

The testimony was given in detail, explaining how the users of

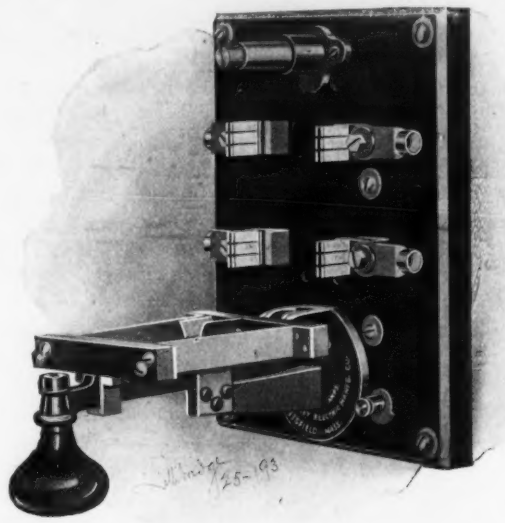


FIG. 2.—SECONDARY PROTECTOR, OPEN.

electric lights have no protection whatever against the accidental charging of the low-pressure house wires by the high-tension line wires, and that under conditions each lamp in the house may become a veritable death trap for any one coming in contact with same. The testimony indicated further that these conditions might occur without any one in the power house or anywhere being the wiser for the accident and nothing suspected of being wrong until some luckless victim drops dead upon touching the highly-charged lamp.

It must be admitted that even in the present enlightened day the ordinary alternating-current installation is susceptible to the danger indicated.

Self-Indicating Fuses.

The new indicator recently brought out by the D. & W. Fuse Company for their enclosed fuses is quite unique among this class of apparatus. They have designated it the "Bull's-Eye Indicator," on

FIG. 1.—SELF-INDICATING FUSE BEFORE BLOWING.

account of its appearance and construction. It is in every way flashless, quiet and reliable. The fuses bear sticker labels with a small circular target, which is without mark and clear. After blowing, a small black spot or "bull's-eye" appears, showing that the fuse has

FIG. 2.—SELF-INDICATING FUSE AFTER BLOWING.

operated and needs renewal. This has been adopted as standard by that company, and is meeting with very general approval of all who have tried it. It is a very ingenious and satisfactory little device.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was easier and offered by brokers on liberal terms. The closing rates were 3½ per cent for 30 to 60 days; 4 per cent for 90 days and 4@4¼ for four months. In the stock market there was a decidedly strong undertone, and although public speculation was quiet the bond market was active and higher on investment buying, which extended to dividend stocks as well. Appreciable, though irregular, advances are noted in railroad and industrial shares, due partially to the recovery in copper and rise in copper stocks, as well as the easing of money, and other favorable circumstances. The United States Steel Corporation's annual report was favorably received, but did not result in activity or advance in its stocks. The traction and electric lists shared the stronger tone of the general market, although the advances were only fractional in most instances. Brooklyn Rapid Transit closed at 65¾, a net gain of ¾, the number of shares sold being 23,095; Metropolitan Street Railway made a net gain of 2⅛ points, closing at 171¾; Manhattan Elevated closed at 135½, being a net gain of ½ point. General Electric remains practically unchanged as to closing price, which was 280, the sales aggregating only 1900 shares. Westinghouse common made a net gain of 1¾, while 1st preferred is quoted at 180. Western Union was dealt in sparingly, the sales aggregating 2510 shares, the closing figure being 91⅜, a net gain of ⅜ point. Following are the closing quotations of Feb. 4:

NEW YORK.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
American Tel. & Cable...	—	90	General Electric.....	279½	280
American Dist. Tel.....	—	36	General Carriage.....	1	1
Brooklyn Rapid Transit.	66	66	Hudson River Tel.....	100	—
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	171¼	172¾
Commercial Cable.....	—	163	N. E. Elec. Veh. Tran...	½	½
Electric Boat.....	25	26	N. Y. Elec. Veh. Tran...	12¾	14½
Electric Boat pfd.....	47	48	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	2¼	1¾	Tel. & Tel. Co. America.	—	—
Electric Vehicle.....	1¾	2½	Western Union Tel.....	91¼	91
Electric Vehicle pfd.....	4	4¾	West. E. & M. Co.....	175½	174
			West. E. & M. Co., pfd..	—	175

BOSTON.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
Am. Tel. & Tel.....	158	158½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	141
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	87⅛	86
Erie Telephone.....	20½	—	Westinghouse Elec. pfd..	—	180
General Electric pfd.....	280	280¼			

PHILADELPHIA.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
American Railways.....	44½	44	Phila. Traction.....	98¼	98
Electric Storage Battery.	56	58	Philadelphia Electric....	3⅞	4
Elec. Storage Batt'y pfd.	56	58	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	5⅞	6	Pa. Elec. Veh. pfd.....	2¼	—

CHICAGO.

	Jan. 28.	Feb. 4.		Jan. 28.	Feb. 4.
Central Union Telephone.	—	86	National Carbon pfd....	83	83
Chicago Edison.....	164	163	Northwest Elev. com....	35	38
Chicago City Ry.....	190	193	Union Traction.....	11¼	11¾
Chicago Telep. Co.....	185	—	Union Traction pfd.....	47	47
National Carbon.....	18¼	18½			

ELECTRIC TUNNEL ROAD.—The Union Terminal Company, of New York, has been incorporated with the Secretary of State with a capital of $100,000, to construct and operate an electrical tunnel road between 9 and 10 miles long between New York and Kings counties. The road is to begin beneath the intersection of Varick and Montrose avenues, Brooklyn, and is to run westerly, underground and under the East River to and under Fourteenth Street, Manhattan Borough ,and under the Hudson River to a point on the boundary lines of the States of New York and New Jersey, due west from the west end of the center line of Fourteenth Street, Manhattan Borough, there to connect with a railway to be built under the authority of the State of New Jersey, continuing westerly in the same general direction to connect with the various railroads entering Jersey City and Hoboken, with branches from Fourteenth Street and Broadway under Broadway, Madison Square, and Madison Avenue to Forty-second Street, to the Grand Central Depot, and from Fourteenth and Hudson Street, southward under Hudson Street, College Place and Greenwich Street to Battery Place, to and around Bowling Green. The directors are Francis H. Leggett, Frederick P. Voorhees, Roy Stone, Charles F. Smillie, Louis L. Stanton, William C. Cox, M. E. Robinson, Appleton D. Palmer and John A. Stewart, of New York City. The project of a terminal company is a revival of a plan proposed in 1891. This contemplated furnishing a Manhattan terminal for all railroads entering Jersey City. Frederick P. Voorhees, Louis L. Stanton and William C. Cox, mentioned in the incorporation papers, are all connected with the Standard Trust Company, of 25 Broad Street.

EVERETT-MOORE SYNDICATE AFFAIRS.—The bankers' committee in charge of the Everett-Moore syndicate's affairs report that conditions are growing more favorable every day. According to latest reports, out of $11,500,000 of credits, extensions have been granted by creditors representing more than $10,000,000, and it is believed that the consents of the remaining creditors will be secured. The Strang Construction Company, which secured the first receiver for the Detroit & Toledo Shore Line Railway, has withdrawn its application, and Receiver Allen F. Edwards, who was appointed through the efforts of Mr. Everett, is now in full charge of the property. The Strang Construction Company will complete the road as soon as possible. The banker's committee expects to dominate to a certain extent, in the affairs of all of the constituent companies controlled by the syndicate. Under its direction, R. W. Judd has been appointed to succeed John Sherwin as treasurer of the Federal Telephone Company, the United States Telephone Company, the Cuyahoga Telephone Company and the Reserve Construction Company. Representation will be arranged for on the boards of the various railway companies, this having already been accomplished in the cases of the Cleveland Electric Railway and the Northern Ohio Traction Company. The committee has practically decided that it will be well for the syndicate to dispose of its interest in the London (Ontario) Street Railway.

ERIE TELEPHONE.—At a meeting of Erie Telephone stockholders it was voted to reduce the board of directors from 15 members to five. The following will constitute the new board of directors: Francis R. Hart, Albert B. Chandler, William Endicott, Jr., Reginald Foster and Philip Dexter. It is stated that Mr. C. W. Morse received $20 per share for the 21,000 shares of Erie Telegraph & Telephone Company stock controlled by him through his ownership of the Telephone, Telegraph & Cable Company, or $420,000. This leaves Mr. Morse with the independent properties of New York and Boston against the $4,000,000 capiltalization of the Telephone, Telegraph & Cable Company, for which he paid some time ago $50 per share for a controlling interest, or about $2,000,000. The amount of money spent in New York and Boston by the independent interests thus far is estimated at about $800,000. In order to make this asset of value, it will be necessary to complete the New York and Boston plants and establish a line between the two cities.

ELECTRIC COMPANY OF AMERICA.—The Electric Company of America has submitted an advance statement to stockholders for the fiscal year ended Dec. 31, 1901, in which it is stated that the net earnings from operating their companies will exceed $327,000, which, after deducting the interest on the bonds of the subsidiary companies, will leave a total of over $275,000 applicable to dividends, or more than 9 per cent on the paid in capital. In this statement for the year 1901 two of the plants, Canton and Auburn, have been owned and operated for five months of the year. The officials confidently expect the net earnings from operating the plants to exceed $300,000 in the year 1902. The company is without floating debt of any kind, with the exception of bills for current expenses, which are paid every month. It has no bonded indebtedness whatever, and has largely reduced that of its subsidiary companies. The annual meeting will be held at the company's office, Camden, N. J., on Tuesday, April 22, 1902.

CONSOLIDATED RAILWAY LIGHTING.—After 5½ hours of argument and voting last week, Mr. Isaac F. Rice, president of the Consolidated Railway Lighting & Refrigerating Company, received a vote of approval from the special meeting of the stockholders held at the company's office, in Jersey City. The meeting was called by those who oppose the methods of the president to require him to answer charges that he had received 10,000 shares of the company's stock to which he was not entitled; that he had refused to sign checks authorized by the board of directors, and that he had, in violation of the by-laws, and without authority, procured the payment of upward of $5,000 of the company's money on an order signed only by himself for the payment of an obligation contracted by himself.

CLEVELAND CITY RAILWAY.—The shareholders of the Cleveland City Railway on Jan. 20 authorized the increase of the capital stock from $8,000,000 to $9,000,000. The new stock, it is stated, will be offered at once to present stockholders to provide for improvements, new equipment and extensions.

INCREASE OF CAPITAL.—The Ft. Wayne Electrical Corporation has increased its capital stock from $500,000 to $800,000, the money to be spent in enlarging its present plant.

LEASE OF METROPOLITAN.—It is stated from Philadelphia that a new company has been formed by the Whitney-Widener-Elkins-Dolan combination to lease the Metropolitan Street Railway system, of New York. The new organization, it is asserted, will be a securities company, so formed as to permit it to hold the stock of any corporation. Its capital will be $30,000,000, which may be increased as necessity arises. It is not the purpose of the company to attempt at this time to effect a consolidation of the other great New York systems—Manhattan and Brooklyn Rapid Transit—with the Metropolitan, but it is admitted that such a merger is ultimately hoped for. The money raised will be used to turn 100 miles of horse railway lines into a modern underground trolley system, and the new securities will guarantee an annual dividend of 7 per cent on the Metropolitan stock, shareholders of the latter to have the right to subscribe to $20,000,000 of the new capital at par to the extent of 45 per cent of their present holdings. The entire issue of capital has been underwritten by Kuhn, Loeb & Co., of New York. The terms of the deal were all settled this week at a conference in New York, and a formal circular of announcement is now being prepared. This will be issued in a few days. Directors living in Philadelphia decline to state the nature of the new corporation or to say who will be its president. It was asserted positively that H. H. Vreeland, president of the Metropolitan, would not be the head of the new corporation.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company has issued a circular announcing that the board of directors has voted to issue at par 4000 shares of new stock to stockholders of record at the close of business, Feb. 8. Shareholders will be entitled to subscribe for the new stock in the proportion of one new share for every eight shares now held. The funds received from the sale of the new stock will go for new construction work.

AMERICAN TELEPHONE & TELEGRAPH.—The subscribers for $10,000 or less American Telephone & Telegraph collateral trust bonds have been allotted their subscriptions in full. Those who have subscribed for over $10,000 of the bonds have been allotted 75 to 80 per cent of their subscriptions. The total offered was $10,000,000.

ELECTRIC HEATERS.—The incorporation is announced in Delaware of the Ellisson Brown Electric Heater Company, of Philadelphia, to construct apparatus for the generation and development of heat by electricity. Capital stock, $250,000.

DIVIDENDS.—The Boston Elevated directors have declared a semi-annual dividend of 3 per cent. Six months ago 3½ per cent was declared, and a year ago 2¼ per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—The heavy snowfalls during the past week, according to advices received by the mercantile agencies, tended to check buying, except of purely seasonable goods at retail, and to limit slightly the volume of demand in wholesale lines. The snow, however, has bettered the crop situation, and the outlook for spring trade as a whole is greatly improved. No diminution in confidence in a large spring business is reported, though Southern trade advices continue unsatisfactory. Other developments of the week are in the main favorable; railway earnings continue satisfactory. Although the car situation is somewhat improved and the iron furnaces in the Chicago district have generally resumed, the acute conditions as to actual supplies of pig iron have been little changed at all markets, with premium paid for quick delivery. The rail mills of the country are filled with orders and are not seeking outside contracts. Among the other metals, a feature has been the marked change in the copper situation, several sharp upward movements of prices occurring. It is claimed that a large business was done on the 11-cent basis, the demand being for consumptive and export account. It is the general belief, however, that a lower level of prices is to prevail for some time to come and that the present upward movement, which has speculative earmarks, will not endure any great length of time. The closing prices were 11⅞ cents for spot Lake, 11¾ cents for electrolytic and 11½ cents for casting. The business failures for the week, as reported by *Bradstreet's*, aggregated 303, as against 292 the week previous, and 238 the same week last year.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric cranes, advise that business conditions are satisfactory, and more than usually so in the volume of orders. This firm has obtained, it is said, the largest order ever placed by one company at one time for electric cranes. This was placed by Allis-Chalmers Company, Edw. P. Allis Works, Milwaukee, Wis., for the new factory buildings at West Allis, and specifies 35 cranes, ranging in capacity from 5 to 75 tons. In addition to this order, Pawling & Harnischfeger have recently booked contracts for 43 electric cranes from other well-known firms, among which are the following: The Aultman & Taylor Machinery Company, Mansfield, O., one 10-ton; Hecla Portland Cement & Coal Company, West Bay City, Mich., three 15-ton; La Belle Iron Works, Steubenville, Ohio, one 10-ton; McMyler Manufacturing Company, Cleveland, Ohio, one 10-ton; the Glamorgan Pipe & Foundry Company, Lynchburg, Va., one 15-ton; Wheeling Steel & Iron Company, Wheeling, W. Va., one 7-ton; the Lorain Steel Company, Johnstown, Pa., four 7-ton; Puget Sound Naval Station, Bremerton, Wash., one 10-ton; Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa., one 10-ton; Baltimore Copper Smelting & Rolling Company, Baltimore, Md., one 5-ton; the Midvale Steel Company, Philadelphia, Pa., one 10-ton and two 5-ton jibs; Grand Trunk Railway System, Portland, Me., one 2-ton; C. W. Hunt Company, West New Brighton, N. Y., one 2½-ton; John Bogart, New York, N. Y., one 14-ton.

KELLOGG TELEPHONE EXCHANGES.—A party of representative telephone men from South Bend and Logansport, Ind., telephone exchanges, consisting of the following: Hon. W. J. Vesey, W. E. Massman, G. W. Pixley, C. H. Warden, E. H. Yarnell, S. M. Foster and C. A. Wiley, were in Chicago on Jan. 29, where they visited the plants of the leading telephone manufacturers, including that of the Kellogg Switchboard & Supply Company, from whom they recently bought a 3000-line common battery exchange for Logansport, and which is about ready for operation. These parties are also about ready to install an exchange of 2000-line capacity at South Bend, Ind. The Illinois Telephone Company, of Jacksonville, Ill., awarded contract Jan. 28 to the Kellogg Switchboard & Supply Company for all necessary apparatus for its new common battery telephone exchange of 2500 ultimate capacity. It is anticipated that within a year it will have 2500 local subscribers.

BIDS FOR TRANSMISSION PLANT.—The Kern Power Company, of Los Angeles, Calif., which is to install a water power electric transmission plant costing about $5,000,000, during the next two years, has called for bids for electrical machinery. According to the specifications, bids will be received up to Feb. 10 next. R. S. Masson, of San Francisco, is the company's consulting electrical engineer. There will be ten 2000-kw generators and 15 900-kw transformers at 26,000 volts. The transmission line from the generating station to Los Angeles will be 110 miles in length, and current will be transmitted at 45,000 volts. The specifications call for several alternate bids, giving the company an opportunity to choose between bar-wound generators at 176 r. p. m. and wire-wound at 231 r. p. m.

RAILWAY LIGHTING & EQUIPMENT.—Vice-President John N. Abbott, of the Consolidated Railway Electric Lighting & Equipment Company, has issued to the stockholders a report of the work thus far accomplished by the company. It shows that the company's system of car lighting by power derived from the axle has been introduced upon 29 railways in the United States and Canada. Recently, the report states, the Pullman Company has entered into a contract with the Equipment Company to equip all of its private cars with the axle system of electric lighting. In addition to this contract, the company during the past month has closed contracts with the Chicago Great Western, the St. Louis & San Francisco, and the Missouri Pacific.

CATALOGUES AND SAMPLES FOR THE AZORES.—Consul Pickerell reports from St. Michael's, Dec. 10, 1901, that he is requested by Mr. Cæsar d'Oliveira, of that island, to secure for his use catalogues and samples as per following memorandum. This gentleman, adds the consul, has had a number of years' experience as a salesman for continental houses. He desires to hear directly from the houses sending catalogues as to prices, discounts, etc. For the present, he expects to pay cash. The catalogues wanted include electrical apparatus, and the samples asked for include bare and insulated copper wire.

COOK'S TELEPHONE DEVICES.—Mr. Frank B. Cook has sold his interest in the Sterling Electric Company, of Lafayette, Ind., to a syndicate headed by H. A. Taylor, of Lafayette, and A. F. Remy, of Crawfordsville. The company will pay royalties for the use of Cook's patents. Walter E. Doolittle will be made president and H. S. Bullock general manager of the new company.

BYTTON BROTHERS, 117 Pearl Street, New York City, have just shipped to their branch house, Abraham & Co, Manaos, Brazil, a large number of Bernstein "Lowatt" lamps, and of Enterprise coffee mills, driven by General Electric motors.

ELECTRIC DRILLS.—The Canterbury Mining Company, of Leadville, Colo., is open for bids on all matters pertaining to electric drills. The company will install a new battery of boilers and electric light plant, and it is thought it will probably install an electric drilling plant.

ELECTRIC HOIST BRIDGE WANTED.—The City Council, of Chillicothe, Ohio, will call for bids on an electric hoist bridge to replace the present Main Street draw.

BUYING COPPER.—The Boston Elevated Railway Company has taken advantage of the low price for copper and has purchased 1,000,000 lbs. of trolley wire on the basis of 11 cents per pound for copper. This is sufficient to last the company a year.

HUGE POWER PLANT IN BALTIMORE.—The United Railways & Electric Company, of Baltimore, Md., has closed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for four electric generators of 2000 kw, or about 2800 hp each. The United Company is operating the old World's Fair Westinghouse machines, which are rated at 750 hp each. These machines were among the most noteworthy exhibits at the Chicago World's Fair, and at that time were the largest lighting generators in the world. The new machines will generate three-phase current at 13,000 volts and 3000 alternations per minute. This current will be transmitted through light cables to sub-stations where, by means of transformers and rotary converters, it will be "stepped down" to direct current at 550 volts for the trolley wires. The contract includes transformers, rotary converters, switchboards and all necessary auxiliary apparatus. This contract is one of a large number of sales of extraordinary size and importance which have recently been made by the Westinghouse Company. The eight 5000-kw alternators for the Manhattan Railway Company, of New York, are the largest in the world, and the contract secured by them for the equipment of the power house for the New York Rapid Transit Subway was also unprecedented in size and the amount of money involved. The New York Rapid Transit power house vies with the one planned for the Underground Railways, of London, in being the largest ever projected. The London power house will also be equipped with Westinghouse machinery. It is worthy of note that the 5000-kw generators furnished to the Manhattan Company and being built for the New York and London Underground railways broke a record which had previously been held by their builders. The 5000-hp alternators at Niagara, which had previously held the record as being the largest in the world, were also built by this company.

A NEW INSULATING MATERIAL.—The defects in inferior marble, slate and other stone of like character when used for a high-tension switchboard have long been an annoyance to electrical designers. A new variety of stone has recently been employed for this purpose, and the results obtained are reported most satisfactory. This stone has in general the appearance of an asbestos fibre, which has been pressed into a solid mass, and the structure of the material is entirely homogeneous. Large quantities of this stone, which is known as "actinolite," have been found in the deposits, and a company known as the North American Actinolite & Asbestites Company has been formed to manufacture articles containing the substance as an insulating material, and has a factory at Tottenville, S. I. Some interesting tests have already been made on the mechanical and electrical properties of actinolite. A large piece of the stone was subjected to a temperature of 3500 degs. for three hours, and was taken from the furnace to be plunged immediately into cold water. This treatment left the stone in exactly the same condition as before the test, proving conclusively its immunity from injury by fire. The electrical properties have also been tested, and have been found to indicate that actinolite is one of the most perfect natural insulators so far discovered. The weight of the stone is about 175 lbs. per cu. ft. The officers of the company are J. A. Bill, president and treasurer; Michael Seitz, secretary, and H. C. Harding, superintendent.

HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., through its New York offices, report receipt of a number of foreign and domestic orders during January. The foreign list includes a 150-hp standard belted engine for Manila, where the machine will be used for lighting purposes. The domestic sales made last month comprise two 600-hp Harrisburg standard tandem compound four-valve engines for the Hopewell (N. J.) Electric Light, Heat & Power Company. These engines are to be each direct connected to 400-kw generators. A 450-hp standard belted engine has been sold for a Seattle (Wash.) plant, intended to drive a General Electric 300-kw alternating-current generator. The Flatiron Building in Twenty-third Street, Broadway and Fifth Avenue, New York, is to be installed with three 160-hp standard engines direct connected to 100-kw Bullock generators. The Ampere Electro-Chemical Company, of Rochester, N. Y., is to be furnished with a 75-hp standard type engine for direct connection to a 50-kw General Electric generator. The General Chemical Company, of Laurel Hill, L. I., has ordered a 50-hp standard belted engine. Two 40-hp direct-connected engines will be installed for lighting in the new building, Albany and Greenwich streets, New York City, and the Kinney Brothers' plant of the American Tobacco Company will be equipped with a small direct-connected Ideal engine for lighting purposes.

THE CANADIAN NIAGARA POWER COMPANY has placed an order with the Canadian General Electric Company, of Toronto, for nine oil immersed water-cooled transformers for transforming from the primary voltage of 11,000 volts, which will be the generated voltage of the new 10,000 ehp generators at Niagara, Ont., to the transmission line voltage of either 22,000, 38,000 or 57,000 volts. These transformers will be used in banks of three transformers for three-phase current, and will carry an overload of 50 per cent for a half hour without undue heating. The insulation between the primary coils and the core, and between the primary and secondary coils will stand a test of 114,000 volts alternating current for one minute, and between the secondary coils and the core a test of 76,000 volts for the same length of time. The transformers will have efficiencies at full load of 98.2, and are to be wound for 25 cycles, which is the frequency of the Niagara current. The details of the big General Electric generators for this Canadian plant were given in our last issue.

MANNING, MAXWELL & MOORE, of 85 Liberty Street, New York City, have this week been awarded an important contract for electric cranes, which are intended to be installed in the New Juniata Locomotive Works and the locomotive repair shops at Altoona of the Pennsylvania Railroad. The cranes, which will be manufactured by the Shaw Electric Crane Company, of Muskegon, Mich., are to be four in number—two for each shop—and will be special overhead travelers of 65-ton capacity. Each of the cranes will have two 7½-ton automatic hoists, one each side of the main hook. They will each be equipped with five motors, aggregating 150 hp. The motors are also to be built at the Shaw works. The value of the contract is about $52,000. There are at present 10 Shaw cranes, varying in capacity from 12½ tons to 60 tons, installed in the same road's Juniata and Altoona shops. The new ordnance shops of the Midvale Steel Company, at Philadelphia, are being equipped with two 60-ton and a similar number of 25-ton Shaw cranes.

CAHALL BOILERS FOR NEW ENGLAND PLANTS.—The Massachusetts Electric Companies, of Boston, have placed contracts with Thayer & Co.'s Boston office for a 2000-hp Cahall horizontal water-tube boiler plant for the Boston & Northern Street Railway Company's plant, and a 1500-hp equipment, which is intended to be installed in the new power station of the Newport & Fall River Street Railway at Newport, R. I. The Thayer Company have also taken an order for a 500-hp plant for an extension of the Lexington & Boston road. The boilers will be built at the Mansfield (Ohio) works of the Aultman & Taylor Company.

CRANE FOR SANDY HOOK.—The C & C Electric Company has just begun work on the installation of a complete electrical equipment for operating the big gantry crane at the Sandy Hook proving ground. The plant will consist of a pair of 30-kw direct-connected generators, and a lot of special weather-proof motors, all of which will be mounted directly on the crane. The specifications were prepared by and the installation will be under the supervision of Mr. E. R. Knowles, the civil and electrical engineer. It will be the first equipment of its kind in this country.

WESTINGHOUSE NIAGARA TRANSFORMERS. — The Cataract Power & Conduit Company, of Niagara Falls, has recently awarded to the Westinghouse Electric & Manufacturing Company a contract for seven 2500-hp, oil-insulated, water-cooled transformers. These transformers will be wound for 2200 volts, two-phase, to 11,000 or 22,000 volts, three-phase, and will duplicate the present equipment in the transformer house at Niagara Falls.

POWER AT RICHMOND, VA.—The Virginia Electric Railway & Development Company, at Richmond, are advertising for bids on new work connected with their power plant, part of which is already in operation. About $200,000 is now to be spent. It is said that the plant as it stands represents a cost of about $1,300,000. E. L. Bemis is president, W. M. Habliston vice-president, and Everett Waddey secretary and treasurer.

FIRE AT WATERBURY, CONN.—A great fire apparently of incendiary origin has occurred at Waterbury, Conn., doing damage estimated from two to five millions. The New England Engineering Company lost its office building, and the Connecticut Railway & Lighting Company has had a lot of trouble from interrupted service and broken circuits, etc. Mr. A. M. Young is prominently interested in these enterprises.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, is busy with foreign shipments of its exhaust heads and the Cross oil filter. Manaos, Brazil, was the southern extreme on the month's shipments, while six large oil filters were sent to Finland. Other important foreign shipments were to London, England, and Vienna, Austria.

TELEPHONES FOR BRITISH INDIA.—The Acme Telephone Company, of 42 Dey Street, New York City, has secured an order through the East Indian house of Tata & Co., 25 William Street, for the telephone equipment of the Victoria office building, Bombay, owned by Mr. Jamsetji N. Tata, the senior partner of that firm.

THE BENNETT BUILDING, Omaha, Neb., is to have a very complete electric service plant, which will consist of two tandem compound engines built by the Ball Engine Company, Erie, Pa., direct connected to Northern Electric generators.

CABLE FOR MEXICAN TRAMWAYS.—The Morris Electric Company, of 15 Cortlandt Street, will to-day make shipment of some $14,000 worth of weather-proof cable to the Mexican Tramways Company, Limited, City of Mexico.

General News.

THE TELEPHONE.

SHEFFIELD, ALA.—The Bell Telephone Company is putting in a metallic system in its exchange at Sheffield. The long-distance line is also being completed from Decatur, Ala.

SONORA, CALIF.—The Mountain Automatic Telephone Company has been granted a franchise to maintain a telephone line between Sonora, Carters, and Stent.

SAN FRANCISCO, CALIF.—A telephone line will be constructed by the California Central Gas & Electric Company, which will connect Petaluma, Santa Rosa, Napa and the company's power-house on the Napa River.

SAN FRANCISCO, CALIF.—The Imperial Telephone Company of California has been purchased by A. G. Whalen, manager of the Woodill-Hulse Electric Company, of Los Angeles, and C. R. Johnson, of Riverside. Local and long-distance business will be carried on by the new owners.

SAN FRANCISCO, CALIF.—The Alaska & Pacific States Telephone Company has been incorporated by Messrs. W. H. Parry, A. L. Kasson, F. A. Wing, S. B. Hicks and C. O'B Redeen. Its purposes are to acquire, build and maintain telephone lines in any of the Pacific Coast States, Alaska and Mexico.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company will construct a telephone line from Jerome to Flagstaff, Ariz., a distance of nearly 40 miles. It will also build from Prescott to Crown King during the coming season. The company has no intention of closing up the gap between its California and Arizona systems in the near future.

GREELEY, COLO.—The Morgan County Telephone Company, capital stock $35,000, has been incorporated by D. E. Gray, George E. Settle and E. J. McMurray.

CHICAGO, ILL.—The Brimfield Telephone Company, of Brimfield, has increased its capital stock to $5,000.

PETERSBURG, ILL.—A private telephone company wants a franchise in this city to compete with the Central Union.

LINCOLN, ILL.—It is stated that the Logan County Telephone Company will seek a franchise from the Pekin, Ill., City Council.

KEMPTON, ILL.—The Kempton Telephone Company has been incorporated, with a capital stock of $1,200 by Carl Schultz, John Bergan and J. T. Corkill.

BUDA, ILL.—The Buda Bradford Telephone Company, capital stock $5,000, has been incorporated by George A. Carper, Parker N. Mason and John J. Gundrich.

CAMPBELL, ILL.—Farmington Citizens' Mutual Telephone Company, capital stock $2,500, has been incorporated by W. H. Smith, J. S. Armstrong, J. R. Orismore.

CANTON, ILL.—The Canton, Sugarville & Fairview Telephone Company, capital stock $2,000, has been incorporated by H. W. Standard, H. A. Kyser and Henry Ellis.

CERRO GORDO, ILL.—The Cerro Gordo Telephone Company has incorporated with $15,000 capital stock. Melvin Welty, A. C. Doyle and Oscar Yarnell are the incorporators.

ELGIN, ILL.—The Elgin Telephone Company may extend its system in the spring. It now has a Stromberg-Carlson switchboard capacity of 40 lines, Swedish-American telephones being used.

ALTON, ILL.—A recent fire destroyed 300 Blake transmitters, thirty-five long distance instruments and about $800 worth of cross arms, wire and other supplies of the Central Union Telephone Company.

EUREKA, ILL.—A telephone company has been organized at Metamora. It will establish a central office and connect with Eureka, Washington, Roanoke, Spring Bay, Cazenovia, Low Point and other places.

SPRINGFIELD, ILL.—The Interstate Independent Telephone Company, incorporated under the laws of New Jersey, with a capital of $3,000,000, has made application to the Secretary of State to do business in the State of Illinois, with a capital stock of $600,000.

CARLINVILLE, ILL.—The presidents of the several companies filed a consolidation bond Jan. 14 in the circuit clerk's office, consolidating the following-named companies: Girard Telephone Company, Modento Telephone Company, Virden Telephone Company, Palmyra Telephone Company, Waverly Telephone Company, and the Hittick Telephone Company. The consolidation is for twenty years, and the fees and rates are fixed without power to change, save by a board of arbitration, which is named and provided. No traffic agreement can be made with any other line. It is said the Kinloch company, of St. Louis, is a part of the company thus formed.

STREATOR, ILL.—The Streator Independent Telephone Company has a present capacity of 560 drops, using Stromberg-Carlson apparatus. It now has 455 subscribers and is a prosperous organization. The company has recently increased the capacity of its underground cables to 1200 metallic lines and it expects to secure that number of subscribers. The company expects to put in a farmers' line switchboard and 500 telephones in the surrounding country this spring, and the indications are that it will have about 1500 telephones in operation in this territory by the end of the year. The company started business on July 1, 1901, with 275 subscribers. Mr. Albert Schuler is manager of the company.

BUCKGROVE, IND.—A telephone line will be erected from Arion to Buck Grove as soon as the weather will permit.

FORT WAYNE, IND.—The National Telephone & Telegraph Company will in a short time build a third line between Fort Wayne and Van Wert, Ohio.

STINESVILLE, IND.—Farmers in the eastern part of this county are erecting a free telephone system from Gosport to Elliottsville, Bloomington and other points.

PRINCETON, IND.—The Independent Telephone Company which is now establishing a plant and exchange here, expects to have the same in operation by Feb. 15.

NORTH MANCHESTER, IND.—The two independent telephone companies operating in this city and the surrounding country have locked horns over patronage and a bitter war is raging.

INDIANAPOLIS, IND.—The Indiana Central Telephone Company has been incorporated. The initial capital is $10,000. The company proposes to build a telephone line through Brown, Lawrence, Monroe and adjoining counties.

SUGAR GROVE, IND.—The farmers of this place and vicinity are organizing a mutual telephone association and about fifty will subscribe. The exchange will be at Dunlaps and there connection will be made with the Home Telephone company's lines.

INDIANAPOLIS, IND.—It is reported that the officials of several of the railroads centering here will in the course of a short time equip all of the principal stations along its line with telephone wires for the use of officials and employes in transmitting orders and messages of the company.

ANDERSON, IND.—Local officials of the Anderson Telephone Company completed the formal transfer of its property to the Delaware & Madison County Telephone Company, during the week. This property is to form a part of the system of the telephone combination recently organized at Ft. Wayne by George W. Beers and others.

ALBANY, IND.—The Albany Telephone Company has been organized here with capital stock of $10,000. The concern is largely backed by Indianapolis capitalists. The company will construct a system to connect with Redkey, Parker, Farmland, Winchester and other towns that already have independent plants. The farmers' lines surrounding the city will also be connected with the local exchange.

OAKLANDON, IND.—The farmers in this vicinity have organized a telephone company and elected the following officers: President, William Hamilton; secretary, John Sellers; treasurer, Cyrus Stoner. They have six miles of the line completed, and are serving about twenty families. They have made connection with the South Morrison Company lines at Oaklandon. The system promises substantial results.

WARSAW, IND.—To enable the independent telephone companies to compete for business with larger corporations, a meeting was recently held in this city by managers of companies operating in seven important county seats of Northern Indiana, and arrangements were made to construct copper lines on the coöperative plan connecting Fort Wayne, Columbia City, Warsaw, Plymouth, Rochester, Logansport, and South Bend.

ALBANY, IND.—Albany citizens have organized an independent telephone company with $10,000 capital stock. The construction of a plant to cover the town and surrounding country, and to connect with the toll lines running over the State, will begin at once. The company will pay special attention to the construction of farmers' lines. Isadore Duddleson has been elected president of the company and E. H. Carter secretary.

WAUKON, IA.—The Standard Telephone Company has increased its capital from $100,000 to $200,000.

CALEDONIA, IA.—A telephone company was organized here for the purpose of building a new farm line to Mt. Ayr.

MELBOURNE, IA.—The Melbourne Telephone Company, capital stock $10,000, has been incorporated by J. E. Retz and others.

CLEARFIELD, IA.—The Clearfield & Lenox Telephone Company will build another line from Clearfield to Lenox in the near future.

WEST BEND, IA.—The West Bend Telephone Company, capital stock $10,000, has been incorporated by Phil Dorweiler and others.

GRUNDY CENTER, IA.—The Farmers' Mutual Telephone Company, which has organized to build a line from here to Monteith, held a meeting and elected O. F. Smith president.

EARLVILLE, IA.—The Standard Telephone Company, of Dubuque, Ia., has bought out the local telephone company which was organized a short time ago and will put in an exchange.

HOPKINSTON, IA.—The Hopkinston Telephone Company expects to increase its business about 100 per cent during the present year. It has at present a 100-drop switchboard and 110 subscribers. Mr. F. C. Reeve is secretary of the company.

POTEAU, I. T.—The Poteau Telephone Company has completed its line to Cameron and contemplates building on to Fort Smith.

TOPEKA, KAN.—The Tonganoxie Telephone Company has been chartered, with a capital of $10,000.

NEW ORLEANS, LA.—The City Council of New Orleans has under consideration the granting of the telephone franchise.

HOWELL, MICH.—The Livingston Home Telephone Company, with main offices at Howell, will establish an exchange at Williamston.

DETROIT, MICH.—The Co-operative Telephone Company has been organized and capitalized at $250,000 for the purpose of establishing an independent telephone system. The officers are: F. F. Ingram, president; Hamilton Carhart, vice-president; Wilbur Brotherton, secretary; C. M. Burton, treasurer. The Co-Operative Company will equip a telephone system in opposition to the Bell company, and when the municipal government is in a position to own a plant of this kind will turn its management over to the city.

LIBBY, MONT.—D. P. Bowers, who owns the Snowshoe mine, is attempting to get all the mine owners in the Libby district interested in a proposition to establish a telephone line to each of the properties where any work is now being carried on and to make Libby the central office of the system.

TRENTON, N. J.—The Printing-Telegraph Company has been incorporated; capital, $5,000. Incorporators: Henry G. Stephens, Benj. Rosenthal, Herman Lewis.

JERSEY CITY. N. J.—The Occidental Telephone & Telegraph Company has been incorporated; capital, $5,000. Incorporators: Russell Robb, Howard L. Rogers, Henry R. Hayes, Clarence F. Walker, Elmer H. Geran.

NEW YORK, N. Y.—Plans were filed with the Building Bureau for a four-story telephone exchange building, to be erected at 110 East Fifty-eighth Street. It is to cost $125,000.

ATHENS, OHIO.—The Grigsville Telephone Company, capital stock $3,000, has been incorporated by H. S. Hoskinton and others.

BATAVIA, OHIO.—The Citizens' Telephone Company, of this place, has been organized, and elected B. W. Gilfillen, Columbus, Ohio, president; J. W. Ranson, Batavia, vice-president, and W. H. Baum, treasurer and general manager.

PLEASANTON, OHIO.—The Pleasanton Telephone Company has been organized by C. M. Pierce, William Pierce, John Cowan and others. They will build a line from Pleasanton to Athens, thus connecting up a number of farmers' lines in this vicinity with the outside world.

GALLIPOLIS, OHIO.—The United States Telephone Company has completed its line from Gallipolis to Ironton, giving Gallipolis connections with all towns in the State. The Gallipolis Telephone Company is planning to build farmers' lines through Bidwell, Vinton, Addison, Cheshire, Perter and Kerr as soon as weather permits.

HAMILTON, OHIO.—The Southern Ohio Telephone & Telegraph Company has been granted a franchise in Hamilton for an independent exchange. O. M. Bake is at the head of the company, which will have long-distance connections through the lines of the United States Telephone Company. The company will commence work in the spring.

SPRINGFIELD, OHIO.—In reply to the general complaint of bad service, Manager Miller of the Central Union Telephone Company, states that within a year the list has been increased from 1500 to 2500. New switchboards have been ordered but have not yet arrived, and until they are installed the service is likely to be somewhat unsatisfactory.

COLUMBUS, OHIO.—Hon. E. J. Bracken, of Franklin County, has introduced a bill in the House providing for the municipal ownership of telephones. It provides that villages and towns may issue bonds for the purpose of building or purchasing telephone plants. Another bill will shortly be introduced fixing the rate of telephone charges throughout the State.

LIMA, OHIO.—J. C. Nolen and F. J. Mason, of Chicago, representing the Columbia Telephone Manufacturing Company of that city, have submitted a proposition to Lima business men with a view to removing the company's headquarters to that city. The company agrees to employ 200 men at the start. It claims to have orders aggregating $150,000 on its books.

CLEVELAND, OHIO.—Dr. Emil Dorn, of Chicago, who has applied for telephone franchises in a number of cities in Ohio, is seeking a grant in Cleveland. He desires to operate the system on a co-operative plan, asking all citizens to become members of the company. Business rates are to be $3 per month and residence $1.50 per month. He has forwarded a draft of his proposed ordinance.

COLUMBUS, OHIO.—Prominent local citizens are endeavoring to form a syndicate with a view to purchasing the stock owned by the Everett-Moore syndicate in the Columbus Citizens' Telephone Company. The holdings of the Cleveland people amount to 60 per cent of the stock. The company has about 6000 telephones in operation and is the best paying property under control of the Federal company, having paid dividends from the start. It is generally believed that the Columbus people will not be able to carry out their plans.

TOLEDO, OHIO.—Judge Wing of the United States Circuit Court, has decided that the National District Telegraph Company, a branch of the Western Union, must secure a franchise before it can operate a call box system throughout the city. The case has been in court for a number of years and has been fought out before five Federal judges. The Western Union company claimed that it owned the District company, and that the call boxes were in reality miniature telegraph offices, and that the company was doing business under a Federal telegraph franchise. The company is now endeavoring to secure a franchise.

BATAVIA, OHIO.—The Batavia Citizens' Telephone Company has elected officers as follows: B. W. Gilfillen, president; J. W. Ranson, vice-president; Wm. Baum, secretary-treasurer and general manager. The company will proceed with the construction of new lines throughout the county as rapidly as possible. Bethel will be wired within the next few weeks and connection will be made with Blanchester, giving long-distance connection throughout the State. Felicity, Chilo, Neville and Moscow will be connected with the lines already built in New Richmond, and it is expected that by July 1 the company will have 500 telephones in Clermont county alone.

MOUNT MORRIS, PA.—The Mount Morris Telephone Exchange Company has been incorporated, with a capital stock of $3,000.

CASTLEWOOD, S. D.—The Castlewood Telephone Company, capital stock $1,000, has been incorporated by Aubrey Lawrence, F. A. Cheever, H. H. Curtis and J. B. Van Horn.

LIVINGSTON, WIS.—The Spitzer-Livingston Telephone Company has filed an amendment changing its name to the Grant County Telephone Company.

SPRING GREEN, WIS.—The Big Hollow Telephone Company, capital stock $1,500, has been incorporated by Martin Hansen, Henry J. Elfefson and Andrew Frederickson.

JANESVILLE, WIS.—The annual meeting of the Badger State Long-Distance Telephone Company was held in this city Jan. 23. The $33,000 indebtedness was cleared up and the head office of the company changed from Milwaukee to Janesville. C. W. Twining was elected president and F. W. Coon secretary.

ELECTRIC LIGHT AND POWER.

MOBILE, ALA.—The general council has accepted the offer of the Electric Lighting Company of Mobile to continue lighting the streets for five years at the rate of $75 per lamp per year. This gives a quietus to municipal and other lighting projects. Mr. George S. Leatherbee is applying for further street railway franchises.

TOMBSTONE, ARIZ.—The Tombstone Consolidated Mines Company has ordered machinery for an electric light and telephone system to be constructed here.

KINGMAN, ARIZ.—A franchise has been granted by the Board of Supervisors of Kingman, Ariz., to H. W. Kemper for lighting the town by electricity for a period of five years. The electric plant must be completed and in operation within nine months.

HIGHLAND, CALIF., has two projected electric lighting propositions. Dr. Baldwin purposes to generate electric power from Mill Creek. A water power electric transmission has been planned by the Arrowhead Reservoir Company in connection with its water system.

SAN FRANCISCO, CALIF.—The Standard Electric Company expects to be ready to test its new electric generating plant at Electra within a short time, and may be ready for commercial business in March next. The power-house equipment includes five 2000-kw, 3-phase generators and step-up transformers for raising the voltage to 60,000 volts for transmission 145 miles to San Francisco. The pole-line extends from the power-house in Amador County to Stockton, thence to Livermore, and to Mission San Jose sub-station. Thence, to the sub-station in Alviso and on to San Francisco, where a sub-station is nearly completed. Here, instead of rotary transformers, there will be five synchronous motors and generators that will produce current of a lower voltage for distribution.

SAN FRANCISCO, CALIF.—The United Electric, Gas & Power Company has sold a controlling interest in its property to a syndicate of capitalists and F. H. Rindge, G. I. Cochrane, Harry Gray and H. C. Merritt. Among the holdings of the corporation are the Santa Barbara street railway system, the bath-house in Los Banos, Calif.; the gas and electric plants in Santa Barbara, Santa Monica, Redondo, Inglewood, Monrovia, San Pedro, Terminal Island and Long Beach, Calif. The officers of the company are: Hulett C. Merritt, president and treasurer; Frederick H. Rindge and B. V. Carter, vice-presidents; George I. Cochrane, secretary and general counsel; J. J. Davis, superintendent; Harry Gray, Louis J. Merritt, Fred. T. Bueneman and Charles E. Scheide, of New York.

SAN FRANCISCO, CALIF.—A number of farmers, residing in the San Gabriel Valley, who use the waters of the San Gabriel River and its tributaries, have sent petitions to Washington, D. C., to strengthen the case of the irrigators against the electric companies, which is now before the General Land Office. The claim is set forth that heretofore and since the government reservation of lands within the San Gabriel forest reserve, made in 1891, the Electric Water Company and the Electric Power Company have unlawfully entered upon the reservation, cut trails and taken possession of properties in the reserved lands; that they have cut undergrowth and threaten to impair the water supply of the irrigators. If this case is settled in favor of the irrigators, it is said that the electric light and power companies, now doing business in the San Gabriel Canyon and furnishing Los Angeles and other California cities with electricity, will be forced to shut down their water-power electric plants.

MITCHELL, IND.—The Lehigh Cement Company at this point is erecting a large plant, including an electric light and power equipment greater in capacity than ordinarily required to light a city of 5000 inhabitants.

MARION, IND.—The Marion Light & Heat Company has purchased and taken over the Mead Electric Light plant of this city. The latter plant has been the subject of much litigation, having been in court for two years, and was in the hands of a receiver.

INDIANAPOLIS, IND.—The American Light & Power Company, of Hartford City, has filed articles of incorporation. The directors are H. C. Uhler, S. V. Perrott and A. G. Perrott. The Summittville Light & Power Company has filed articles of incorporation; capital stock, $3,600. The directors are Jno. N. Gordon, William C. Gordon and Homer E. Howard.

INDIANAPOLIS, IND.—The Board of Public Works is insisting on inserting a clause providing for municipal ownership in all franchises granted for electric light, heating or power plants, if the city wishes to buy them at the expiration of the franchise period. It is said that the clause will be applied to the new city lighting contract, which is to be let in the early spring.

SOUTH BEND, IND.—The St. Joseph & Elkhart Power Company is progressing rapidly with the construction of the dam in St. Joe River near here, to furnish power for an immense electric plant to supply the four interurban manufacturing cities of South Bend, Mishawaka, Elkhart and Goshen. The company has contracted for 250,000 lbs. of copper wire, at a cost of $30,000.

LAKE CHARLES, LA.—Petitions are being circulated to decide whether or not an election will be held on the question of issuing $40,000 improvement bonds for water, light and sewerage.

CANTON, OHIO.—The Central Heat & Power Company has been granted a franchise to build a lighting and heating system in this city.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has applied for a franchise in Fostoria for an electric lighting and steam heating plant to be operated in connection with its power station. The move is the result of the unpopularity of the local lighting company, which is fighting the town.

STEUBENVILLE, OHIO.—The Central District & Printing Telegraph Company is planning to make improvements in this city during the coming year that will cost $100,000. A new exchange building to cost $25,000 will be erected, a new switchboard will be installed, and a large portion of the present overhead system will be placed underground.

OTTAWA, ONT.—The Capital Power Company, of Ottawa, is about to enlarge its water-power plant at Deschenes. A large submarine cut is being made by which the company will be in a position to supply 1250 electric horse-power,

in addition to its present capacity. The cut is to be 200 feet wide by 240 feet long and six feet deep. The work is very difficult and will occupy the greater part of the year to complete it, the cutting being made through solid rock.

MANCHESTER, VA.—After opening bids it has been decided to recommend to the Council the acceptance of the bid of the Richmond Passenger & Power Company for furnishing lights to the city. The competition was very strong, and this company offered not more than seventy lights free of charge, for five years. This company desires, it is said, to keep out of Manchester the Virginia Electrical Railway & Development Company.

WAUKESHA, WIS.—A petition is being circulated asking that a committee be appointed to investigate municipal ownership of the city electric lighting plant. The movement seems to be a popular one and is receiving considerable support.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company has made arrangements to install $25,000 of new machinery to duplicate that already in use.

LA SALLE, ILL.—Fire destroyed the power-house of the City Electric Railway Company. But two cars remain of the once well-equipped plant. Loss, $60,000; partially covered by insurance.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Traction Company, formerly the Indianapolis & Greenfield Company, has filed a mortgage in favor of the Central Trust Company to secure a loan of $200,000. The money will be applied to construct the extension to Knightstown, and thence to Richmond.

PITTSFIELD, MASS.—Residents of this city, Westfield and Springfield will incorporate the Western Massachusetts Street Railway Company, to operate a street railway from Westfield to Lee. The length of the road will be 40 miles and the capital stock $300,000.

WILMINGTON, N. C.—The Wilmington Street Railway Company, made up of combined interests previously existing, has effected a reorganization with Hugh MacRae, president, and C. P. Bolles, Jr., M. F. H. Gouverneur, W. W. Randolph and Junius Davis, directors. The capitalization is $200,000.

TRENTON, N. J.—The Electric Railways Corporation has been incorporated in Trenton with a capital stock of $100,000 to carry on a general business of controlling or directing electric railways. The company will examine and report on questions arising in connection with the organization, location, franchises, rights of way, character and cost of construction and traffic of electric lines. The incorporators are Louis S. Phillips and Horace B. Hord, New York, and Suydam F. Wheeler, Jersey City.

SEA CLIFF, N. Y.—The Nassau County Railway Company has filed its certificate of incorporation at Albany, with a capital stock of $25,000.

HALIFAX, N. S.—It is the intention of the Halifax Tramway Company to make extensive improvements to the lighting department of its plant. It is also proposed to install another battery of boilers.

CANTON, OHIO.—At the annual meeting of the Canton-Akron Railway Company the old officers and directors were re-elected.

FINDLAY, OHIO.—The Findlay & Marion Electric Railway Company has been granted a 25-year franchise into the center of Findlay.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway has completed arrangements for the absorption of the Elyria, Grafton & Southern Railway.

BRILLIANT, OHIO.—Directors of the Wheeling Traction Company have decided to locate the car barns and power station for the Steubenville-Wheeling line at Brilliant.

OTTAWA, OHIO.—It is reported that the Toledo & Lima Traction Company and the Defiance, Ottawa, Kenton & Columbus Railway are figuring on building a joint power-house in this place.

CINCINNATI, OHIO.—The Indiana & Ohio Traction Company of Brookville, Ind., has been incorporated. George M. Shirk, A. Mucker, J. C. Shirk, G. E. Bennett and A. E. Showalter, Brookville, are directors. Capital, $100,000.

SPRINGFIELD, OHIO.—The Springfield & Western Railway to New Carlisle is to be extended to connect with the line which is to be built from Springfield to Piqua by way of Lawrenceburg, North Hampton, Addison and Casstown.

COLUMBUS, OHIO.—W. A. Cullen, of Newark, N. J., who has the contract for building the Urbana, Mechanicsburg & Columbus Railway, has secured a site for the power-house near Plain City and will commence work on the building about March 1.

CLEVELAND, OHIO.—The appointment of Allen F. Edwards as receiver of the Detroit & Toledo Shore Line has been confirmed by Judge F. J. Wing, of the United States Circuit Court, Cleveland. The receiver will complete the work on the line as soon as possible.

KENTON, OHIO.—The Dayton & Kenton Traction Company has elected officers as follows: E. M. Hopkins, New York, president; W. W. Steelee, Detroit, vice-president; H. S. Forgy, New Carlisle, Ohio, secretary; C. L. Hubbard, Dayton, treasurer, and B. H. Rannels, Dayton, general manager.

DAYTON, OHIO.—The Dayton & Xenia Traction Company has secured a right of way from Xenia to Washington C. H., with a franchise to enter the latter place. The company is also considering extending its Spring Valley line to Waynesville and Wilmington, adding 17 miles to that division. It is making many improvements to its existing lines.

COLUMBUS, OHIO.—The annual meeting of the Columbus, London & Springfield Railway held a few days ago, resulted in the election of the following officers: J. S. Harshman, president; John G. Webb, vice-president; A. E. Appleyard, treasurer; E. J. Green, secretary, and H. A. Fisher, general manager. Cars will be placed in operation from Columbus to West Jefferson within a few days.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company is preparing plans for the erection of a large power-house in Youngstown, and when completed the present station at Edinburg will be used as a sub-station. Plans are also being prepared for a fine passenger and freight station to be erected at the New Castle terminus. The New Castle extension will be placed in operation about Feb. 1.

COLUMBUS, OHIO.—The Appleyard syndicate is preparing to erect at Hebron a large three-phase generating station which will furnish power for the Columbus, Buckeye Lake & Newark Traction Company's line and other roads running out of Columbus. It will operate in connection with a similar station now located on the Columbus, London & Springfield Railway. Sub-stations will be erected on the various lines at intervals of fifteen miles.

DAYTON, OHIO.—Stockholders of the Ft. Wayne, Dayton & Cincinnati Traction Company have elected the following-named officers: Dr. S. George, president; D. W. Le Fetra, New York, vice-president; Charles L. Hyde, Pierre, S. D., second vice-president; Charles W. Gebhart, secretary-treasurer, and Clifford E. Swayne, auditor, the last two mentioned of Dayton. The directors have increased the capital stock from $1,000,000 to $5,000,000.

CHILLICOTHE, OHIO.—The Chillicothe Electric Railway, Light & Power Company has elected officers as follows: W. A. Story, president; M. Kramer, vice-president; George A. Vaughters, secretary-treasurer, and Joseph Myers, general manager. The company will commence work in the near future on a power-house to be located near the center of the city. It will be equipped with two large units, and the present station will be used as an auxiliary plant.

CLEVELAND, OHIO.—The Cleveland & Southern Railway Company has elected officers as follows: W. H. Lamprecht, president; A. H. Pomeroy and A. E. Aikins, vice-presidents; F. L. Fuller, secretary; F. T. Pomeroy, treasurer.

CLEVELAND, OHIO.—Stockholders of the Cleveland & Eastern Railway, the Cleveland & Chagrin Falls Railway and the Chagrin Falls & Eastern Railway have ratified the merger of the three properties into the Eastern Ohio Traction Company. A permanent organization will be effected in a short time.

CLEVELAND, OHIO.—The Cleveland City Railway Company held its annual meeting Jan. 20. J. B. Hanna and Dan P. Eells were dropped from the board of directors. The directors are J. H. Wade, G. G. Mulhurn, L. W. Prior, W. B. Sanders, R. R. Rhodes, Chas. A. Otis, H. E. Andrews and C. F. Emery. Senator Mark Hanna was elected president; C. F. Emery, vice-president; John Ehrhardt, secretary-treasurer and George Mulhern, general superintendent.

OTTAWA, ONT.—It is said to be the intention of the Velvet Mines, Limited, of Rossland, B. C., to apply to the British Columbia Legislature for a charter to construct an electric railway between Rossland and the Red Mountain Railroad, a distance of thirty miles. The charter will also ask for the establishment of telegraph and telephone systems. The estimated cost is placed at $300,000.

OTTAWA, ONT.—Several electric railway systems are outlined in the notices of applications to the Ontario Legislature. The largest is intended to make a network of the locality between London, Goderich and Owen Sound, Ont. The London (Ont.) Railway Company asks incorporation and power to construct and operate electric railways from London, Ont., to Glencoe, from Delaware to Strathroy and from London to Ingersoll; also power to construct radial extensions from any of the points mentioned. The Morrisburg Electric Railway seeks incorporation, and power to construct and operate a system from Morrisburg to Winchester, Ont., and a branch line to Chesterville and Morewood.

TITUSVILLE, PA.—The Titusville Electric Street Railway has passed into the hands of a company of New York capitalists. W. R. Brown, a New York promoter, financed the transaction, and represents Charles Pfeifer and other capitalists. It is understood that the new company will extend the line to Meadville.

QUEBEC, QUE.—Mr. Holman, of Quebec, manager of the Canadian Electric Light Company, has, on behalf of certain capitalists, offered to build an electric railway in the town of Levis, Que.

JOHNSON CITY, TENN.—Citizens of Johnson City are considering a street railway franchise.

CHATTANOOGA, TENN.—The officials of the Chattanooga Railway Company have decided, it is reported, to construct a line to Rossville, Ga.

JONESBORO, TENN.—A franchise has been granted to a company to build an electric railway from Jonesboro, in Washington County, to Johnson City via the Soldiers' Home.

AUSTIN, TEX.—The Northern Texas Traction Company, of Forth Worth, has increased its capital stock from $2,000,000 to $2,500,000.

SALT LAKE CITY, UTAH.—The Oregon Electric Company has completed the purchase of lands extending up the Clackamas River, a distance of six miles. The management announces that surveyors will locate a trolley line from Portland south. The line will be completed to Garfield, a distance of 25 miles, by Nov. 1, 1902. It is estimated that 2400 horse-power can be generated from the falls.

RICHMOND, VA.—At a meeting of the stockholders of the Passenger & Power Company the old officers were re-elected.

WILLIAMSBURG, VA.—The Hampton & Yorktown, and the Jamestown & Williamsburg Electric Railways are now said to be assured, and that work on both lines will begin early in the year.

RICHMOND, VA.—It is stated that the financial embarrassment of the Everett-Moore Syndicate, of Cleveland, Ohio, will have no effect whatever upon the Petersburg-Richmond electric line, which is being built by the Cleveland Construction Company, in which the Everett-Moore Company is interested. The Everett-Moore Syndicate owns or controls a number of telephone lines in Virginia.

THE AUTOMOBILE.

MR. FRICK'S AUTOMOBILES.—Mr. H. C. Frick, the wealthy steel man, has just received two new automobiles, which came direct from Paris. The machines are said to cost $15,000 in Paris.

ELECTRIC AUTOMOBILES.—The Carlton Hotel, London, has made a big stride to the advantage of its guests. It has inaugurated a day and night electric carriage service for the hotel at the ordinary rates charged for a hired horse carriage. The first to order one of these electric landaulettes, with their smart lemon and black bodies, was Lady Brassey. Mr. Paris Singer, of the City & Suburban Electric Carriage Company, has inaugurated a system which will save

trouble to the town users of these carriages. His firm houses, cleans, and cares for a purchaser's machine, renews its parts, charges its batteries, and does everything for it—including insuring it against fire and accidents—for a fixed sum per annum.

COLORADO SPRINGS, COLO.—Gen. William J. Palmer, the millionaire railroad builder, who recently distributed $3,000,000 among old employes, dislikes the present style of automobiles, no matter what pattern or make, and is willing to let the world know where he stands on the horseless carriage proposition. In a deed conveying to the city of Colorado Springs a tract of ground northeast of this city, known as the Austin Bluffs Park site, he has inserted this clause: "Until horseless carriages shall be improved so that they are as noiseless and odorless as horse-drawn vehicles, horseless carriages shall not be permitted to enter or travel over or through any portion of said property herein conveyed for purposes of a park." This shows a decided preference for electrics.

A LONG RUN.—Messrs. F. F. Cimiotti and nephew, Ferd. Cimiotti, of New York City, have arrived in Staunton, Va., having made the entire trip in a Toledo steam carriage over frozen country roads, a distance of over 400 miles. They made the trip in four days, taking it in easy stages and without mishap. The best stretch of road they encountered was the Valley pike, a distance of some 120 miles, and over this road they frequently made record breaking speed; in some instances equaling the speed of the local passenger trains, which paralleled them and in sight most of the way. This is the best long-distance test the automobile has had in Virginia, and seems to thoroughly demonstrate the practicability of the machine wherever good roads exist. Mr. Cimiotti, the senior, is owner of extensive mineral properties from Buffalo Gap to Variety Springs.

NEW INDUSTRIAL COMPANIES.

THE MARION COUNTY CONSTRUCTION COMPANY, of Indianapolis, Ind., has been incorporated to construct, repair electric railways, etc. The incorporators are G. W. Seibert, W. E. Smith and C. W. Wells.

THE GREEN TELEPHONE & ELECTRIC MANUFACTURING COMPANY has filed articles of incorporation in Milwaukee, Wis. The incorporators are J. H. Green, C. Hensing and T. J. Seeley. The capital is $3,000.

THE ELECTRICAL CONSTRUCTION COMPANY, which was recently incorporated, with San Francisco as the principal place of business, and a capital stock of $25,000, fully paid up, has opened offices and warerooms at 29 New Montgomery Street. Mr. F. B. Williams is president and W. S. Hochstadter secretary of the new corporation.

LEGAL.

CANNOT TAX FRANCHISES.—The New Jersey Court of Errors and Appeals has reversed the Supreme Court decision and decided that municipalities cannot tax franchises. A supplemental opinion sets forth that a franchise is property and taxable as such, but the right to tax has been reserved by the State and not delegated to the municipalities.

EICKEMEYER WINDING.—The U. S. Circuit Court of Appeals has reversed the decree of the Circuit Court and dismissed the plaintiff's bill in the case of the General Electric Company against the Webster & Dudley Street Railway Company. The subject matter of the suit was on the question whether the Eickemeyer coil winding for dynamo electric machines was infringed.

OBITUARY.

MR. H. D. BENNETT.—The death is announced of Mr. Herbert D. Bennett, president of the American District Telegraph Company of Columbus, Ohio.

MR. JAMES MILLIKEN, a director of the Western Union Telegraph Company, died in New York on Feb. 3. He was born in 1824, and was for a long time a leading merchant and citizen of Philadelphia. He retired from business after the Civil War. He was unmarried.

PERSONAL.

DR. HENRY A. EVERETT, of the Everett-Moore syndicate, has been re-elected president of the Cleveland Electric Railway Company.

MR. ANSON W. BURCHARD, a consulting engineer of the General Electric Company, has been elected second vice-president of the Greene Consolidated Copper Company.

MR. HEULINGS LIPPINCOTT, president of the National State Bank of Camden, has been elected a director of the American Railways Company, vice E. J. Mathews, deceased.

MR. MYRON T. HERRICK, the Cleveland electrical and street railway manager and banker, has declined the Ambassadorship to Italy on the ground of great pressure of private business.

MR. C. E. KAMMEYER announces that he has purchased control of the *Telephone Magazine* of Chicago, and will again appear as its editor and manager. New offices have been taken in the Medinah Temple.

DR. OLIVER LODGE, as president of the Society of Psychical Research, delivered a remarkable address last week, when he held that it was impossible to deny the probability of the existence in space of an immense range of life and intelligence of which at present we knew nothing really convincing as to evidence in its behalf.

MR. W. C. WHITNEY has just announced his intention of retiring from active business life, saying with regard to Metropolitan Street Railway that it is in the excellent management of Mr. Vreeland. Estimates put Mr. Whitney's fortune at $25,000,000, and even more.

PROF. W. L. ROBB, who for seventeen years has held the chair of Physics in Trinity College, Hartford, Conn., is considering a call to establish a department of electrical science in the Rensselaer Polytechnic Institute, Troy, N. Y. He graduated from Columbia University in 1880, and from Berlin University in 1883.

MR. J. J. BELLMAN, who has been one of the assistant engineers with Westinghouse, Church, Kerr & Company for the past two years, has entered on new duties with H. B. Coho & Company at 149 Broadway. Mr. Coho is to be congratulated on securing a partner having the wide experience in the engineering field which Mr. Bellman's connection with the Crocker-Wheeler Company and the Westinghouse companies has given him. It is their intention to make a specialty of high class installations for private lighting plants.

MR. ALBERT A. CARY, the well known mechanical engineer, writes to the *New York Times* questioning the statement of Mr. W. B. Parsons that forced draft will not remove vitiated air from the New York Central tunnel. He calls attention to the plans laid by him for the District Attorney before the Grand Jury. By this system, with a series of electrically driven, exhaust fans, placed in the parkways above the tunnel and with a proper distribution of fresh air intakes, the air in the tunnel can be kept in such condition that the carbonic acid present would not exceed 12 parts per 10,000. Contractors are willing to do the work under guarantee and forfeiture.

Trade Notes.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has recently closed a contract for a large generator and several motors for a new municipal plant at East Grand Forks, Minn.

THE ELECTRIC APPLIANCE COMPANY, Chicago, general western agent for Richmondt conduit, is busy these days taking care of the orders. The January sales of this conduit have been larger than ever before in the history of the agency.

CHASE-SHAWMUT FIRE.—Under date of Feb. 1 the Chase-Shawmut Company, Boston, Mass., announces that a serious fire in its factory has completely crippled it, and that it will be unable to fill any orders for the present. The company will reconstruct its factory at once.

DYNAMOS AND MOTORS.—The Eck Dynamo & Motor Works, Belleville, N. J., describes and illustrates the construction of its dynamos and motors for direct current, in Bulletin No. 21, issued during January. The construction of these machines is very clearly illustrated, and the dimensions of the various types are given in tabular form.

POCKET TELEPHONE DIRECTORY.—A very handy telephone directory of electrical concerns and individuals in Chicago has been issued by the Guarantee Electric Company of that city. The fact that this is the sixth edition of this directory is evidence that it is very popular. The booklet is vest pocket size, and it gives the street addresses as well as the telephone numbers.

AUTOMOBILE GRAPHITE.—The Joseph Dixon Crucible Company, Jersey City, N. J., has gotten out a booklet containing 51 testimonial letters from well-known doctors, professional men and others, regarding the use of graphite in the lubrication of the working parts of automobiles. This lubricant is equally well adapted to all classes of automobiles whether they are propelled by steam, gasoline or electricity.

A MODERN FACTORY.—One of the most completely equipped factories for the manufacture of electrical and mechanical apparatus is that of Frederick Pearce, 18 and 20 Rose Street, New York. In addition to the latest machinery and appliances, he has the best of talent in the engineering and development line, and is able to turn out the best of workmanship for electrical concerns. His facilities are of great benefit to inventors wishing to develop their inventions.

PHILLIPS'S MORSE AUTOMATIC TELEGRAPH.—Messrs. J. H. Bunnell & Company, 20 Park Place, New York, are pushing Phillips's Morse Automatic telegraph apparatus. This instrument enables a person to learn telegraphy at home. The sending is automatic, and in receiving the speed can be slowed down to suit the beginner. The instrument can be used as well for automatic rapid telegraphy, and is very responsive to high speed signals. Bunnell & Company issue a neat circular giving a lot of interesting information about this apparatus. Mr. Phillips is a master of art of telegraphy and his "friendly talk with beginners" which forms a part of the contents of this circular will be read with much interest and pleasure by old as well as new telegraphers.

"STAINOFF."—This is the name of a preparation now being introduced by the D. M. Steward Manufacturing Company, Chattanooga, Tenn., to clean the hands of dirt, stains, etc. It is recommended for the removal of ink and shop stains, and it is stated that engineers and machinists can go home with clean hands if they use "Stainoff." According to a leaflet published by the Steward Company this substance will remove all kinds of stain and dirt from the hands, and it is said to be perfectly harmless to the skin. It is recommended for stenographers, typewriters, bookkeepers, housekeepers, painters, printers, artists and engravers, besides machinists and engineers. "Stainoff" is stated to be such a universal cleansing agent that there is hardly anything that it cannot be used for, where cleanliness is desired. The company's New York office is at 107 Chambers Street.

THE GREGORY ELECTRIC COMPANY, of Chicago, of which A. O. Kuehmsted is president, has found it necessary to enlarge its quarters. This great electric "bargain house" of the West finds its business in second-hand apparatus growing commensurately with the wonderful growth shown in all other lines of trade. The enlargement of power houses with prosperous times has put more good second-hand electrical machinery than ever into this company's warerooms, and the demand is of course good for machinery that can be delivered at once without the long wait necessary to fill factory orders for new dynamos, motors and transformers. When such second-hand machinery can be bought for immediate delivery from such a large and long-established house as the Gregory Electric Company, accompanied by that company's guarantee, which is an assurance that the machinery has been thoroughly overhauled, and is as good as ever, it is not strange that this company does a large and increasing business. The stock it has constantly on hand to select from is so large that it is strange if the need cannot be met unless very large units are wanted. The repair department is large, well equipped and well supervised, and turns out a high class of work not only in repairing the second-hand apparatus bought, but in repairing for customers. The concern is a standing testimony to the business genius and enterprise of the Messrs. Kuehmsted, who have conducted it for some years past.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 28, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

691,739. ELECTRICAL COMMUTATOR; E. Batault, Geneva, Switzerland. App. filed Aug. 9, 1900. The commutator is a hollow cylinder containing a globule of mercury which moves from segment to segment by gravity as the commutator turns.

691,742. RANGE INDICATOR; A. LeBlanc, New York, N. Y. App. filed May 4, 1901. An apparatus by which the range and azimuth can be speedily and accurately transmitted from the range finder to the guns. The receiving instruments are galvanometers giving direct readings of the required measurements, and they are affected from the transmitting station by varying the difference of potential across the terminals of the galvanometer circuits in proportion to the measurements to be indicated.

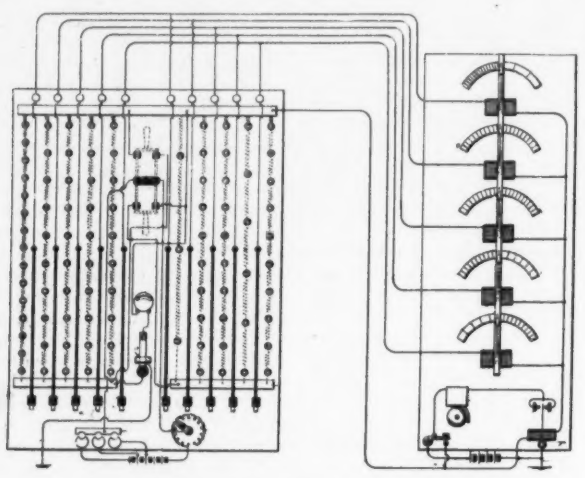
691,766. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 12, 1900. Details of construction.

691,780. ELECTRICAL SWITCH; C. J. Kintner, New York, N. Y. App. filed Oct. 29, 1900. The movable terminal of the switch is a spring so arranged when the circuit is closed, that its free end bears endwise against the fixed terminal, thus causing the spring to be bent or buckled under pressure, so that when it is forced away from the fixed terminal, it will leave the same with a sudden or snap action.

691,793. INSULATION; W. S. Moody, Schenectady, N. Y. App. filed Jan. 28, 1899. An oil insulator is provided with trays of chlorid of calcium over which atmospheric air leading into the insulator, passes, and by which the air is robbed of its moisture. The object is to keep the oil free from moisture.

691,808. COLLECTOR FOR SURFACE-CONTACT RAILWAYS; William B. Potter, Schenectady, N. Y. App. filed June 12, 1899.

691,809. ELECTRIC CONTROLLER; William B. Potter, Schenectady, N. Y. App. filed July 19, 1900.



691,742.—Range Indicator.

691,810. ELECTRIC RAILWAY SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Sept. 20, 1899.

691,815. COHERER; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 16, 1901. The granular material in the tube is subjected to the action of a pair of solenoids which are energized each time the impulse traverses the tube.

691,820. ELECTROMEDICAL BELT; S. J. Spalding, Canton, Ohio. App. filed Aug. 23, 1899. Details.

691,821. ELECTRICAL ARC LAMP; H. C. Spinney, Lynn, Mass. App. filed July 20 ,1898. A floor for the clutch is mounted just above the cap of the inner globe and retains the cap at its normal position when the globe is removed.

691,824. CONTROLLING APPARATUS FOR ELEVATORS OR HOISTS; A. Sundh, Yonkers, N. Y. App. filed Sept. 6, 1901. A controlling apparatus especially adapted for dumb waiters, wherein devices on the car itself are first operated to predetermine the limit of travel of the car, and then the car is started by closing the door of the shaft or operating other controlling devices at the floor where the car happens to be.

691,834. METHOD OF SYNCHRONIZING ALTERNATORS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 30, 1900. (See Current News and Notes.)

691,851. ELECTRICAL ARC LAMP; H. E. Etheridge, McKeesport, Pa. App. filed Sept. 28, 1901. Means are provided in the gas check for automatically aligning the carbon and laterally adjusting it to permit it to freely move through the gas check.

691,871. INSULATING AND PACKING MATERIAL AND PROCESS OF MANUFACTURING SAME; M. Raphael, L. Elias, Breslau, Germany. App. filed Oct. 11, 1900. A layer of asbestos is covered by a layer of mica formed of small pieces of mica arranged like the scales of a fish.

691,874. SWITCH OUTLET AND RECEPTACLE BOX; M. Robertson, Newton, Mass. App. filed Nov. 21, 1901. A switch receptacle or outlet box having ears or lugs, provided with leveling screws and attaching screws for securing the box directly to the lath of other woodwork entirely independent of the plaster.

691,949. SUPPORT FOR ELECTRIC CONDUCTORS AND RESISTANCE; H. W. Leonard, New York, N. Y. App. filed Jan. 10, 1901. A metallic conductor arranged upon a support of mineral insulating material, the conductor being secured to the support by means of a vitreous glaze having a fusing-point so low that it melts before the difference between the expansion of the conductor and the support causes the conductor to become so loose on the support as to materially change its position thereon.

692,004. SELF-EJECTING PLUG FOR TELEPHONE SWITCHBOARDS; Charles F. Butte, San Francisco, Calif. App. filed April 30, 1901. (See page 270.)

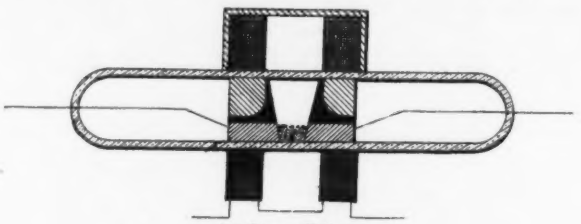
692,005. AUTOMATIC ELECTRIC SWITCH; C. F. Butte, San Francisco, Calif. App. filed May 1, 1901. A switchboard plug containing an electromagnet and a latch which automatically ejects itself from the socket.

692,007. GAS DETECTOR; O. Freymann and C. Tolman, Brooklyn, N. Y. App. filed April 15, 1901. A circuit closer sensitive to heat is treated with a chemical composition which becomes heated when exposed to the action of gas.

692,012. COVERING ELECTRIC CONDUCTORS WITH INSULATING MATERIAL; G. E. Heyl-Dia, Manchester, England. App. filed Dec. 17, 1900. The invention consists in covering the cable with pure rubber and vulcanized rubber in one operation, by coating the vulcanized rubber on one side with pure rubber before applying it to the cable.

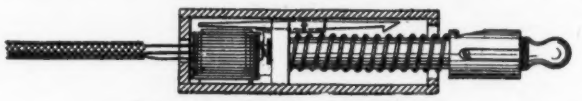
692,013. INSULATING COVERING MATERIAL FOR ELECTRIC CABLES, CONDUCTORS, ETC. G. E. Heyl-Dia, Manchester, England. App. filed Nov. 1, 1901. Covers the article of manufacture described in the preceding method patent.

692,021. REGULATION OF ROTARY CONVERTER E. M. F.; B. G. Lamme, Pittsburg, Pa. App. filed April 17, 1901. (See Current News and Notes.)



691,815.—Coherer.

692,022. WINDING FOR ELECTRIC MACHINES; B. G. Lamme, Pittsburg, Pa. App. filed June 26, 1901. A slotted core having short outer bars and long inner bars and double strap end connectors, the strap ends being separated and fastened to both sides of the bar ends and those which are fastened to the short bars being both located at one side of the long bars.



692,005.—Automatic Electric Switch.

692,054. ELECTRICAL CLOCK; F. Frick, Waynesboro, Pa. App. filed June 29, 1901. Details.

692,085. ELECTRIC SIGNAL MECHANISM FOR OVERHEAD TROLLEY SYSTEMS; W. R. Sterns, Portland, Oregon. App. filed Sept. 14, 1901. A signal system in which current is delivered to a signal line from the trolley wire by the passing of a trolley, the invention residing in the details of the cutting-out and cutthing-in devices.

692,118. REVERSING DEVICE FOR OVERHEAD ELECTRIC CARRIERS; A. S. Cliff, East Orange, N. J. App. filed April 19, 1901. A bell crank on the carrier, is struck by a projection and the reversing switch on the carrier thus thrown.

692,121. ALTERNATING CURRENT MOTOR; D. E. Coulson, Galesburg, Ill. App. filed March 2, 1901. The circuit of the starting coils is opened by a switch operated by centrifugal force, when the normal speed is attained.

692,136. MEANS FOR REGULATING SPEED OF CARS ON OVERHEAD ELECTRIC RAILWAYS; H. M. Harding, Englewood, N. J. App. filed April 19, 1901. The invention consists in insulating the line at portions where it is desired to reduce the speed, allowing the current to pass around the insulated portion through a shunt circuit, and connecting the insulated portion with the shunt circuit by a resistance of the required amount.

692,137. SUPPORT FOR TROLLEY AND TRACK WIRES FOR SUSPENDED CABLE ROADS; H. M. Harding, Englewood, N. J. App. filed April 19, 1901. A curved hanger is supported from a cable and itself supports the trolley and track wires of a carrier system.

692,189. SWITCHING MECHANISM FOR INTER-CONNECTING TELEPHONE LINES; Albert K. Andriano, San Francisco, Cal. App. filed April 16, 1900. (See page 270.)

692,217. SNAP SWITCH; A. Sundh, Yonkers, N. Y. App. filed July 31, 1901. The snap action in both directions is caused by a magnet acting on the movable part of the switch instead of the spring commonly used.